



ELECTRONIC SYSTEMS TECHNICIAN

Competencies / Objectives

Level One

MODULE 33101-04 – INTRODUCTION TO THE TRADE

1. State the purpose of the electronic systems industry and describe the role of an electronic systems technician in the industry.
2. State the role played by industry associations and be able to identify key associations.
3. State the rules for professional and ethical conduct.
4. Describe the importance of codes and standards and explain how they affect the work of the electronic systems technician.
5. Recognize some of the tools used in the industry.
6. Fill out a time sheet.
7. Fill out a job sheet.

MODULE 33102-04 – CONSTRUCTION MATERIALS AND METHODS

1. Describe the composition and uses of the common types of residential building materials.
2. Identify the major structural components of a residential building.
3. Describe the composition and uses of the common types of commercial building materials.
4. Describe the common methods of residential and commercial construction
5. State the major steps in the construction of a frame residence.
6. Explain common terms used in construction.
7. Identify various types of suspended ceilings.
8. Describe how cable is run from building to building.
9. Select appropriate drills, bits, and cutting tools and make openings in various types of construction materials, including:
 - Lumber
 - Concrete
 - Concrete block
 - Steel
10. Install plywood on a gypsum board wall.

MODULE 33103-04 – PATHWAYS AND SPACES

1. Describe various types of cable trays and raceways.
2. Identify and select various types and sizes of raceways and fittings.
3. Identify and select various types and sizes of cable trays.
4. Identify various methods used to install raceways.
5. Demonstrate knowledge of NEC® raceway requirements.
6. Describe procedures for installing raceways and boxes on various surfaces.
7. Make a conduit-to-box connection.
8. Select cable support hardware for various applications
9. Install a cut-in box in drywall and run inner duct from the box to the ceiling.

MODULE 33104-04 – FASTENERS AND ANCHORS

1. Identify and explain the use of threaded fasteners.
2. Identify and explain the use of non-threaded fasteners.
3. Identify and explain the use of anchors.
4. Demonstrate the correct applications for fasteners and anchors.
5. Install fasteners and anchors.

MODULE 33105-04 – JOB-SITE SAFETY

1. Demonstrate safe working procedures in a construction environment.
2. Explain the purpose of OSHA and how it promotes safety on the job.
3. Identify electrical hazards and how to avoid or minimize them in the workplace.
4. Explain safety issues concerning lockout/tagout procedures, personal protection using assured ground-ing and isolation programs, confined space entry, respiratory protection, and fall protection systems.

MODULE 33106-04 – CRAFT-RELATED MATHEMATICS

1. Identify similar units of measurement in both the English and metric systems and know which units are larger.
2. Convert measured values in the English system to equivalent metric values and vice versa.
3. Express numbers as powers of ten.
4. Determine the powers and roots of numbers.
5. Solve basic algebraic equations.
6. Recognize various geometric figures.
7. Use the Pythagorean theorem and trigonometry to make calculations involving right triangles.
8. Convert decimal feet to feet and inches and vice versa.

MODULE 33107-04 – HAND BENDING OF CONDUIT

1. Identify the methods of hand bending conduit.
2. Identify the various methods used to install conduit.
3. Use math formulas to determine conduit bends.
4. Make 90-degree bends, back-to-back bends, offsets, kicks, and saddle bends using a hand bender.
5. Cut, ream, and thread conduit.

MODULE 33108-04 – LOW-VOLTAGE CABLING

1. Explain the various sizes and gauges of wire in accordance with the American Wire Gauge (AWG) standards and determine the proper gauge for an application.
2. Read and identify markings on conductors and cables.
3. Describe the different materials from which conductors are made.
4. Describe the different types of conductor insulation.
5. Describe the color coding of insulation.
6. Identify selected NEC® low-voltage cable classifications.
7. Plan and set up for a cable pull.
8. Properly install a pull line for a cable pulling operation.
9. Prepare the ends of conductors for pulling.
10. Safely pull cable through conduit in vertical and horizontal pathways.
11. Wrap, tie, fasten, label, and protect cable, and explain the importance of maintaining the proper slack.
12. Describe the installation of cables in cable trays.
13. Describe and/or demonstrate a residential low-voltage cable installation.
14. State the restrictions imposed by the NEC® on the uses of various types of cable.

Level Two

MODULE 33201-05 – DC CIRCUITS

1. Define voltage and identify the ways in which it can be produced.
2. Explain the difference between conductors and insulators.
3. Explain how voltage, current, and resistance are related to each other.
4. Using the formula for Ohm's law, calculate an unknown value.
5. Describe the function of resistors and explain their color codes.
6. Explain the different types of meters used to measure voltage, current, and resistance.
7. Using the power formula, calculate the amount of power used by a circuit.
8. Explain the basic characteristics of series, parallel, and series-parallel circuits.
9. Using Kirchhoff's laws, calculate the voltage drop and current in series, parallel, and series-parallel circuits.
10. Find the total amount of resistance in series, parallel, and series-parallel circuits.

MODULE 33202-05 – AC CIRCUITS

1. Calculate the peak and effective voltage or current values for an AC waveform.
2. Calculate the phase relationship between two AC waveforms.
3. Describe the voltage and current phase relationship in a resistive AC circuit.
4. Describe the voltage and current transients that occur in an inductive circuit.
5. Define inductive reactance and state how it is affected by frequency.
6. Describe the voltage and current transients that occur in a capacitive circuit.
7. Define capacitive reactance and state how it is affected by frequency.
8. Explain the relationship between voltage and current in the following types of AC circuits:
 - RL
 - RC
 - LC
 - RLC
9. Describe the effect that resonant frequency has on impedance and current flow in a series or parallel resonant circuit.
10. Define bandwidth and describe how it is affected by resistance in a series or parallel resonant circuit.
11. Explain the following terms as they relate to AC circuits:
 - True power
 - Apparent power
 - Reactive power
 - Power factor
12. Explain basic transformer action.

MODULE 33203-05 – SEMICONDUCTORS AND INTEGRATED CIRCUITS

1. Identify electronic system components.
2. Describe the electrical characteristics of solid-state devices.
3. Describe the basic materials that make up solid-state devices.
4. Describe and identify the various types of transistors and explain how they operate.
5. Describe and connect diodes.
6. Describe and connect light-emitting diodes (LEDs).
7. Describe and connect silicon-controlled rectifiers (SCRs).
8. Identify the leads of various solid-state devices.
9. Describe integrated circuits.
10. Identify a microprocessor and applicable pin numbers.
11. Explain the purpose of logic gates.
12. Build a simple circuit using an LED and a diode; a simple bridge rectifier circuit; and a holding circuit using an SCR, LED, and a pushbutton.

MODULE 33204-05 – BASIC TEST EQUIPMENT

1. Explain the operation of and describe the following pieces of test equipment:
 - Ammeter
 - Voltmeter
 - Ohmmeter
 - Volt-ohm-milliammeter (VOM)
 - Continuity tester
 - Voltage tester
2. Explain how to read and convert from one scale to another using the above test equipment.
3. Explain the importance of proper meter polarity.
4. Define frequency and explain the use of a frequency meter.
5. Explain the difference between digital and analog meters.
6. Use an analog or digital multimeter to measure AC and DC voltage, AC and DC current, and resistance.
7. Use a clamp-on ammeter to measure AC current.
8. Perform a continuity test on a basic circuit to test for open shorts.

MODULE 33205-05 – POWER QUALITY AND GROUNDING

1. Explain the purpose of grounding.
2. Determine the *National Electrical Code*[®] (NEC[®]) requirements for electrical system and telecom-munications equipment grounding.
3. Locate the cause of a ground fault.
4. Recognize and describe the purpose of the components used for grounding and bonding a tele-communications system in a typical commercial multi-story building.
5. Recognize and describe the purpose of the components used in a lightning protection system for a typical high-rise building.
6. Define clean, pure power relating to AC power quality and describe the types of abnormalities and their sources that can cause poor AC power quality.
7. Recognize and describe the purpose for using various AC power system protection and conditioning devices, including:
 - Isolation transformers
 - Surge protecting devices
 - Power line conditioners
 - Harmonic and noise suppression filters
 - Motor and engine-generator sets
 - Uninterruptible power supplies
8. Select and test DC power supplies used in electronic equipment.
9. Recognize different types of storage batteries and describe the advantages and disadvantages of each type.
10. Describe cable shielding and grounding techniques used to minimize EMI.
11. Describe the types of problems that can be caused by static electricity and how to prevent them.
12. Use a ground resistance tester to test for a low-voltage ground.

Module 33206-05 – Introduction to Electrical Blueprints

1. Explain the basic layout of a blueprint.
2. Describe the information included in the title block of a blueprint.
3. Identify the types of lines used on blueprints.
4. Identify common symbols used on blueprints.
5. Understand the use of architect's and engineer's scales.
6. Demonstrate the use of an architect's scale.
7. Interpret electrical drawings, including site plans, floor plans, and detail drawings.
8. Read equipment schedules found on electrical blueprints.
9. Describe the type of information included in electrical specifications.
10. Look for devices on blueprints and perform a take-off.
11. Identify the type of infrastructure specification.

MODULE 33207-05 – SWITCHING DEVICES AND TIMERS

1. Identify and describe the operation of commonly used types of switches.
2. Classify switches based on schematic diagram symbols, according to the number of poles and throws.
3. Identify and describe the operation of photoelectric devices.
4. Describe the operation of a solar cell.
5. Describe the uses and operation of relays.
6. Explain the differences between electromechanical and solid-state relays.
7. Identify and describe the operation of various types of timing devices.
8. Install and program a timer.

MODULE 33208-05 – WIRE AND CABLE TERMINATIONS

1. Identify various types of communications connectors.
2. Identify various coaxial connectors.
3. Identify basic fiber-optic connectors.
4. Identify common crimp connectors.
5. Prepare and terminate a cable or wire with various types of connectors.

MODULE 33209-05 – INTRODUCTION TO CODES AND STANDARDS

1. Identify the difference between codes and standards.
2. Identify trade-relevant codes and standards and their applications.
3. Explain how to use and find information in the *National Electrical Code*® (NEC®).
4. Explain the role of testing laboratories.
5. Use the NEC® to determine the specific requirements for a given telecommunications and/or life safety system application.
6. Use the applicable ANSI/TIA/EIA standards to determine the specific requirements for a given telecommunications and/or life safety system application.

MODULE 33210-05 – COMPUTER APPLICATIONS

1. Define terms commonly used in discussing computers and networks.
2. Identify the components of a personal computer and discuss the function of each.
3. Upload and download files to a security, lighting control, or fire system.
4. Build and test a null modem cable.
5. Assemble a personal computer.
6. Back up system configuration files.
7. Load application software on a computer and use the software to perform a task.
8. Explain the function of each level of the open systems interconnection (OSI) reference model for data communication.
9. Describe the characteristics of and uses for various types of data transmission media.
10. Describe the function of the Internet as it relates to network protocols.

MODULE 33211-05 – ADVANCED TEST EQUIPMENT

1. Explain the operation and use of specialized test equipment used in the checkout and troubleshooting of electronic equipment, cables, and cabling systems.
2. Select the correct item of test equipment to be used in specific situations.
3. Use an oscilloscope to measure various waveforms.
4. Set up and use selected cable testers to check out cables and evaluate the performance of copper and optical fiber cable.
5. Use a signal generator to generate various waveforms.
6. Use a frequency meter to determine the frequency of a specific circuit.

Level Three

MODULE 33301-04 – CABLE SELECTION

1. Select cables for specific applications.
2. Calculate the voltage drop for various applications.
3. Interpret and apply NEC® regulations governing conductors and cables.
4. Size cable conductors for a given load.
5. Understand and apply various formulas and charts for load calculations.

MODULE 33302-04 – BUSES AND NETWORKS

1. Describe the characteristics of and uses for various types of data transmission media.
2. Explain how communication devices are connected to a transmission medium.
3. Explain the methods of providing access control.
4. Explain the operating principles of network topologies.
5. Explain how information is transferred using different network topologies.
6. Describe the functional interrelationship between the OSI model layers and the network protocol.
7. Describe the function of the Internet as it relates to network protocols.
8. Explain the composition of microcomputer-based local area networks (LANs).
9. Describe selected proprietary control networks.
10. Describe the functions of bridges, routers, and gateways.
11. Identify the protocols used with wide area networks (WANs).
12. Describe X-10™ and other power line carrier standards.

MODULE 33303-04 – FIBER OPTICS

1. Explain the basic principles of fiber-optic technology, including:
 - Fundamentals, benefits, and applications of a fiber-optic system
 - Operational considerations of a fiber-optic system
 - Construction of an optical fiber
 - Various types of fiber-optic cable
2. Describe the design, operation, and performance of a fiber-optic transmitter and receiver.
3. State the types and construction of fiber-optic detectors.
4. Explain the desirable features and connector losses of a fiber-optic connector or splice.
5. Demonstrate the installation of fiber-optic cabling and support equipment.
6. Describe and/or demonstrate the applications and types of fiber-optic splicing/termination.
7. Explain and/or demonstrate the testing procedures for fiber-optic systems.

MODULE 33304-04 – VIDEO SYSTEMS

1. Describe what video is and how it works.
2. Define video signal characteristics for various electronic video devices.
3. Given a video output source, determine appropriate display technology for its presentation.
4. Describe the difference between RGB, RGB sync-on-green, and RGBHV.
5. Describe interlaced and progressive scanning.
6. Describe digital TV (SDTV and HDTV) standards.
7. Identify various processing equipment, and describe its role in the video chain.
8. Describe various cabling and distribution issues.
9. Recognize various video connectors used in a video system.

MODULE 33305-04 – WIRELESS COMMUNICATION

1. Describe the fundamental principles of wireless radio frequency (RF) communication.
2. Identify the basic components used in wireless systems and explain the function of each.
3. Describe the principles of wireless personal communication.
4. Explain the basic operating principles of infrared systems and identify the various types of devices used in those systems.
5. Explain the operating principles and applications of wireless computer networks.
6. Explain the operating principles and applications of satellite communication systems.
7. Identify the equipment used when testing and troubleshooting wireless communication systems and explain the purpose of each.
8. Install and test a radio frequency (RF) or infrared (IR) wireless communication system.
9. Install an antenna.

MODULE 33306-04 – SITE SURVEY, PROJECT PLANNING, AND DOCUMENTATION

1. Describe the general procedure or steps involved when estimating a job for the purpose of submitting a bid.
2. Describe the general procedure or steps required to properly plan and complete a job once a contract for the job has been awarded.
3. Interpret contractual documents, working drawings, and specifications pertaining to a job to determine the requirements and scope of the work.
4. Perform a site survey in order to establish or confirm the installed locations of new and/or existing equipment and the routing of the related cabling.
5. Develop a schedule for completing a job or task from start to finish that efficiently accomplishes the work and is also compatible with the work performed by other trades.
6. Recognize and interpret the various types of forms and other documentation used when estimating and planning a project.

MODULE 33307-04 – MAINTENANCE AND REPAIR

1. Explain the difference between maintenance and repair.
2. Identify the common causes of system and equipment failures.
3. Use electrostatic discharge (ESD) control devices and techniques when handling ESD-sensitive equipment and components.
4. Use manufacturers' troubleshooting aids to identify system problem(s).
5. Isolate computer-related problems to hardware or software.
6. Isolate common faults in wiring and equipment.
7. Identify common preventive maintenance measures.
8. Interpret preventive maintenance and inspection schedules.

MODULE 33308-04 (MT101) - INTRODUCTORY SKILLS FOR THE CREW LEADER

1. Discuss current issues and organizational structure in the construction industry today.
2. Understand and incorporate leadership skills into work habits, including communication, motivation, team building, problem solving, and decision-making skills.
3. Demonstrate an awareness of safety issues, including the cost of accidents and safety regulations.
4. Identify a supervisor's typical safety responsibilities.
5. Show a basic understanding of the planning process, scheduling, and cost and resource control.

MODULE 33309-04 – RACK SYSTEMS

1. Identify various types of electronic equipment racks.
2. Select the appropriate rack for a given application.
3. Establish proper grounding of racks to ensure personnel safety and minimize signal interference.
4. Explain proper ventilation techniques to avoid overheating of rack-mounted electronic equipment.
5. Describe the installation practices for rack-mounted equipment.
6. Prepare a rack layout.
7. Calculate power requirements and heat dissipation requirements for a rack installation.
8. Assemble a rack, including lacing rails and vent fans.
9. Populate a rack with equipment.

Level Four

MODULE 33401-03 – FIRE ALARM SYSTEMS

1. Understand the unique terminology associated with fire alarm systems.
2. Describe the relationship between fire alarm systems and life safety.
3. Identify and explain the role that various codes and standards play in commercial and residential fire alarm applications.
4. Describe the characteristics and functions of various fire alarm system components.
5. Explain and describe the different types of circuitry that connect fire alarm system components.
6. Describe the theory behind conventional, addressable, and analog fire alarm systems and explain how these systems function.

MODULE 33402-03 – INTRUSION DETECTION SYSTEMS

1. Correctly use the trade terminology associated with intrusion detection systems.
2. Identify types and describe characteristics of sensors, notification devices, and control panels.
3. Select the correct sensors, notification devices, and control panels for various applications.
4. Explain and describe the different types of circuitry that connect intrusion detection system components.
5. Describe the different methods of communication and monitoring.
6. Explain introductory intrusion detection system design methods and considerations.
7. Describe introductory intrusion detection system installation considerations.
8. Install and wire an intrusion detection system consisting of sensors, notification devices, and a control panel.
9. Program a control panel, and describe the different components, inputs, and programming options used in controlling intrusion detection systems.
10. Test and troubleshoot an intrusion detection system.

MODULE 33403-03 – AUDIO SYSTEMS

1. Identify the primary components of an audio system and explain the basic operation of each.
2. Identify typical audio system applications for sound reinforcement.
3. Identify various audio input devices and describe their effects on audio signaling.
4. Identify and describe various processing options for audio signals.
5. Identify and describe various controls for mixing and combining audio signals and their effects on the signals.
6. Explain the use of amplifiers in all phases of audio signaling.
7. Specify proper cabling selection criteria for a given audio system.
8. Identify four primary speaker types and explain their application and use in an audio system.
9. Identify and use various measurement devices, meters, and other electronic tools used for audio systems.
10. Describe typical audio system troubleshooting techniques.

MODULE 33404-03 – OVERVIEW OF NURSE CALL AND SIGNALING SYSTEMS

1. Explain key terms related to nurse call systems.
2. Identify the codes and standards that apply to the installation and operation of nurse call systems.
3. Describe the different types of nurse call systems and explain their differences.
4. Explain the limitations on connections between nurse call systems and other systems.
5. State the general installation guidelines that apply to nurse call systems.

MODULE 33405-03 – CCTV SYSTEMS

1. Describe typical uses for CCTV systems.
2. Identify the components of a CCTV system.
3. Describe recording types and media used for CCTV applications.
4. Describe the types of cameras used in CCTV systems.
5. Describe the use and selection of various lenses for use in a CCTV system.
6. Explain cabling options for a CCTV system.
7. Describe the use of amplifiers in a CCTV system.
8. Compare analog and digital CCTV system signals.
9. Define installation requirements for CCTV systems.
10. Describe the tools used for CCTV system troubleshooting.

MODULE 33406-03 – BROADBAND SYSTEMS

1. Draw a block diagram of a selected CATV/ SMATV/MATV system head end.
2. Describe the signal flow for selected processing paths in the head end of a CATV/SMATV/ MATV system.
3. Identify the different assemblies and components used in CATV/SMATV/MATV systems and describe their function.
4. Select and terminate coaxial cables used for specific applications.
5. Calculate CATV/SMATV/MATV distribution system gains and losses.
6. Use selected test equipment to make measurements and checks in CATV/SMATV/MATV systems in order to evaluate system operation.

MODULE 33407-03 – ACCESS CONTROL SYSTEMS

1. Explain the operation of typical entry control systems and their associated access control methods.
2. Describe the different applications and relative advantages and disadvantages of various methods of access control.
3. Identify and explain the following types of entry equipment and their advantages and disadvantages:
 - Entry barriers
 - Locking devices and accessories
 - Entry/exit readers
4. Explain the types of available controllers.
5. Identify and explain primary and backup power sources.
6. Describe general installation guidelines for entry control system equipment.
7. Install a typical reader for an entry control system.

MODULE 33408-03 – SYSTEMS INTEGRATION

1. Define the term systems integration, and identify typical situations when you might encounter systems integration.
2. Describe the best practices for interoperability and system performance.
3. Explain the various interconnection options and protocols commonly used for integration.
4. Describe the network configurations used and the wiring schemes and fault-tolerant procedures designed for system redundancy.
5. Describe various user interfaces available for integrated systems monitoring and control.
6. Identify custom application-driven solutions commonly used in current high-tech building automation systems.

MODULE 33409-03 – SYSTEM COMMISSIONING AND USER TRAINING

1. Describe the phases of the system commissioning process and explain how they apply to the commissioning of specific types of electronic systems.
2. Demonstrate or describe how to prepare for and conduct user training classes.

MODULE 33410-03 – MEDIA MANAGEMENT SYSTEMS

1. Explain the benefits of a media management system.
2. Identify the major components of a media management system and explain their functions in the system.
3. Describe the database and operating software used to control a media management system.
4. Describe the various devices used to store media in a media management system.
5. Describe the types of playback and display devices used in media management systems.

MODULE 33411-05 – TELECOMMUNICATIONS SYSTEMS

1. Explain common trade terms relating to telephone systems.
2. Briefly describe the history of telephones and the operation of the plain old telephone service (POTS).
3. Describe the operation of analog telephones.
4. Identify the main types of business telephone systems and describe their differences.
5. Identify the components used in key systems and traditional private branch exchange (PBX) systems.
6. Describe the differences between analog and digital telephone systems.
7. Describe the commonly used optional features for key systems and traditional PBX systems.
8. Describe emerging technologies.