

# Electronics

## Curriculum Guide

### Program Description

MCTI's Electronics program has a well-equipped electronics lab that provides up-to-date, hands on training. Students in the Electronics program learn entry-level skills appropriate to most electronic businesses and industries. Courses help prepare students for entry-level employment in industrial/electronics maintenance. More than 75 percent of the student's time is spent in the lab with hands-on training exercises.

### Electronics Program Admission Requirements: None

### U.S. Department of Labor Occupational Profile:

*Students who most closely match the occupational profile for an Electronics Service Technician are selected for enrollment.*

- **Aptitude/Abilities:** Above average verbal and numeric aptitudes, manual/finger dexterity, motor coordination, spatial/form perception, learning ability and mechanical reasoning skills. Demonstrated ability to interpret technical instructions in mathematical and diagrammatic form and the ability to logically solve problems with abstract and concrete variables.
- **Work Keys:** Reading/Locating Information/Applied Math – 4
- **CASAS Scaled Score:** Reading & Math 236-240
- **Environment:** Industrial
- **Physical Demands:** Light to Medium
- **Temperament:** Is able to make good judgments; can perform precision work and a variety of tasks.

### Certificate of Completion Programs (SOC Code):

- Assemble/Tester (51-2022)
- Communication AV Cable Installer (49-9052)
- Electronic Systems Installer (49-2097)
- Alarms System Technician (49-2098)
- Alternative Energy Installer (47-2231)
- Electronics Technician (49-2094)
- Industrial Tester/Installer (49-2094)
- Industrial Electronics Technician (49-2094)

All students in the Electronics program choose a certificate track before entering Electronics or after the first term. Depending on the certificate track chosen, students may be in the Electronics program from two to six terms.

At the end of each term, the instructor invites those students who demonstrate academic progress by maintaining an accumulated grade point average or 2.0 or better and good employability skills to advance to the next term.

Students are given the option to sit for the ETA Certified Alarm System Technician Certificate, Alternative Energy Certificate and the Residential Energy Systems Integrator Certificate from the Electronics Technicians Association.

**Required Courses for Certification**

*Students must demonstrate academic progress (satisfactory grade point average) and good employability skills to advance from term to term.*

**Assembler/Tester (AC/DC Courses) (Two Terms)**

Course Number	Course Name	Credits
EL 101A	Applied Technical Math I	2
EL 111	Electric Circuits I	4
EL 114A	Electric Circuits I Lab	6

EL 120A	Applied Technical Mathematics II	2
EL 121	Electric Circuits II	4
EL 124	Electric Circuits II Lab	6

**Communications AV Cable Installer (Two Terms)**

Course Number	Course Name	Credits
EL 101A	Applied Technical Math I	2
EL 111	Electric Circuits I	4
EL 114A	Electric Circuits I Lab	6

**One of the following:**

SU 120	Cabling Technology	4
EL 160	Cabling Technology	4

## Elective (Instructor Approval)

EL 680	Independent Study Projects	8
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**Electronic Systems Installer (Two Terms)**

Course Number	Course Name	Credits
EL 101A	Applied Technical Math I	2
EL 111	Electric Circuits I	4
EL 114A	Electric Circuits Lab	6
ES 115	Basic Electronic Systems	4

**One of the following:**

SU 120	Cabling Technology	4
EL 160	Cabling Technology	4

## Elective (Instructor Approval)

ES 116	Audio-Visual Systems	4
ES 117	Electronic Systems Projects	4

**Alarm System Technician (Three Terms)**

EL 101A	Applied Technical Math I	2
EL 111	Electric Circuits I	4
EL 114A	Electric Circuits I Lab	6
EA 137	Alarms Systems I	12
EA 147	Alarms Systems II	12

## Elective (Instructor Approval)

EL 160	Cabling Technology	4
EA 157	Alarm Systems III/Co-op	12

**Electronics Technician (Four Terms)**

Course Number	Course Name	Credits
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**Prerequisites: AC/DC courses**

EL 130	Semiconductor Devices	2
EL 131	Semiconductor Devices Lab	4
EL 132A	Electronic Circuits	2
EL 134A	Electronic Circuits Lab	4
EL 143A	Digital Circuits and Introduction to Microprocessors	12

**Industrial Tester/Installer (Four Terms)**

Course Number	Course Name	Credits
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**Prerequisites: AC/DC courses**

EI 411	Mechanical Drive Systems I	4
EI 412	Pneumatics Fundamentals	4
EI 414	Commercial Wiring & Tools	4
EI 415	Power Distribution Systems	4
EI 417	Electrical Motor Control I	4
EI 425	Electrical Control Wiring	4

## Industrial Electronic Technician (Seven Terms)

Course Number	Course Name	Credits
<b>Prerequisites: AC/DC courses</b>		
EI 411	Mechanical Drive Systems	4
EI 412	Pneumatics Fundamentals	4
EI 413	Rotating Electrical Machines	4
EI 414	Commercial Wiring & Tools	4
EI 415	Power Distribution Systems	4
EI 417	Electrical Motor Control I	4
EI 422	Electro Pneumatics	4
EI 425	Electrical Control Wiring	4
EI 427	Electrical Motor Control II	4
EI 429	PLC I Introduction/ Troubleshooting PLCs	4
EI 434	Programming/Installing PLCs I	4
EI 437	AC Drives, Braking and Starting	4
<b>Electives (Instructor Approval)</b>		
EL 130	Semiconductor Devices	2
EL 131	Semiconductor Devices Lab	4
EL 132A	Electronic Circuits	2
EL 134A	Electronic Circuits Lab	4
EI 421	Mechanical Drives II	4
EI 432A	Hydraulics	4
EI 438	Using and Troubleshooting a PLC System with RSLogix	4
EI 439	PLCs II Application Development and PLC Instructions	4
EI 441A	Basic Robotics	4
EI 448A	Troubleshooting Servo Control Systems	3

***Instructors, program managers, and/or the referring counselor may recommend employability skills and elective classes based on the student's needs, abilities, interest and behaviors. Job Seeking Skills is required for all students anticipating to graduate from MCTI.***

## Course Descriptions

### EA 137: Alarms Systems I

This course applies DC concepts (Ohm's law, series, and parallel circuits) to the troubleshooting of alarm systems. **Topics covered:** resistor color code, Ohm's law, series circuits, parallel circuits, and use of DMM to troubleshoot alarm systems.

### EA 147: Alarms Systems II

Students with basic knowledge about alarm systems learn additional skills in alarm installation and servicing. Course prepares students to take and pass the National Alarm Association of America Installer Certification Test. **Topics covered:** installation, adjustment, and troubleshooting of burglar and fire alarm systems; alarm control panels, sensors; CCTV, central stations, emergency- powered backup systems, fire detection devices, PROM programming, relays, audible and visual output indicators, test-taking.

### EA 157: Alarms Systems III/Co-op

This hands-on course takes place via an off-campus alarm systems internship, or through on-campus laboratory exercises. Students install, test, and troubleshoot security, fire and medical alert systems; experience is provided in inspection, testing and repair. **Topics covered:** security, fire and medical alert alarm systems in residential and commercial settings.

### EI 411: Mechanical Drive Systems I

This introductory course teaches the fundamentals of mechanical transmission systems used in industrial, agricultural, and mobile applications. **Topics covered:** mechanical energy transmission concepts, torque, speed, power and work, mechanical safety, gear ratios, speed ratios, component operation and installation, chain drives, V-belt drives, flexible jaw couplings, solid couplings, pillow-block type bearings, shafts, keyways, spur gears, motor mounting, motor leveling, soft foot, straight edge and feeler gage alignment, multiple shaft alignment, manufacturer's component data, component selection, and basic system design.

### EI 412: Pneumatics Fundamentals

This introductory course focuses on the construction, trouble-shooting and maintenance of pneumatic systems. Emphasis is on working safely. **Topics covered:** compressed air characteristics, physical properties, scientific laws, compressed air production, distribution and preparation, control of a single and double acting cylinder, indirect and memory control, automatic return, OR and AND logic functions, flow control, quick exhaust, sequence valve, pressure regulator, pneumatic timer, coordinated motion control.

### EI 413: Rotating Electrical Machines

An introductory course in rotating electric machines. The course covers electric machine construction, troubleshooting, maintenance and safety. Students learn how to operate, install, analyze performance, and select electric machines for various applications. **Topics covered:** DC Series Motors, DC Shunt Motors, DC Compound Motors, Split Capacitor, AC Single Phase Motor, Capacitor Start AC Single Phase Motor, Two Capacitor AC Single Phase Motor, Three-Phase AC Induction Motor, Generators, Motor Speed Measurement, Motor Torque Measurement, Motor Power Measurement, Motor Performance Measurement, Motor Performance Analysis

### EI 414: Commercial Wiring and Tools

This course familiarizes the student with commercial electricity, the National Electrical Code (NEC) and wiring principles and practices. It prepares students for electrical and control wiring classes, labs and activities. **Topics covered:** safety and lock out tag out, tools, electrical print reading, wiring, conductors, boxes and conduit bodies, over current protection, service in distribution, transformers, grounding, branch circuits and feeders.

### EI 415: Power Distribution Systems

In this introductory course students learn industry-relevant skills to enable them to construct, troubleshoot, maintain and repair power distribution systems. Industry standard safety practices are followed throughout the course. **Topics covered:** conduit bending, installation, sizing and selection; IMC, EMT and flexible conduit; bus plug installation, wire sizing, circuit protection, disconnect selection and installation; fitting and selection; system layout, and schematic interpretation.

**EI 417: Electrical Motor Control I**

This introductory course teaches electric relay control of AC electric motors found in industrial, commercial, and residential applications. Students learn to operate, install, and design AC electric motor control circuits for various applications.

**Topics covered:** motor safety, lockout/ tagout, troubleshooting methods, interpreting ladder diagrams, system design, component operation, motor control applications, control transformers, manual motor starters, magnetic motor starters, motor overloads, and AC induction motors.

**EI 421: Mechanical Drives II**

This highly-interactive course is a continuation of Mechanical Drive Systems I. The course focuses on the fundamentals of mechanical transmission systems used in industrial applications. **Topics covered:** heavy duty V-belt drives, V-belt selection and maintenance, synchronous belt drives, lubrication concepts, precision shaft alignment, couplings, and heavy duty chain drives.

**EI 422: Electro Pneumatics**

In this course, students with a basic knowledge of pneumatics study design, construction, troubleshooting and maintenance of electro-pneumatics systems. Industry safety standards are emphasized. **Topics covered:** ISO symbology, ladder diagrams, operation and application of standard pneumatic and electrical components, designing basic circuits electro-pneumatic, solenoids, pneumatic valves, electrical sensors, transducers, actuators, timers and counters, memory and pilot control, logic and sequence control.

**EI 425: Electrical Control Wiring**

This course is for students with basic knowledge of electrical motor control and hand tools. Students learn to construct, troubleshoot maintain and repair wiring in electrical control systems. Industry safety standards are emphasized **Topics covered:** wire termination, bundling, running, and installation; control panel, wire sizing and splicing, raceway layout, control panel layout, terminal block installation, and conduit sizing.

**EI 427: Electrical Motor Control II**

This course is a continuation of Electrical Motor Control I (EI-417). Students continue to operate, install, design, and troubleshoot AC electric motor control circuits for various applications. Circuit faults are introduced using either the manual fault insertion or the computer-based fault insertion system.

Students learn how to troubleshoot motor control circuits under realistic conditions.

**Topics covered:** troubleshooting methods, types of switches (e.g., limit, pressure, liquid level, pushbutton and selector switches); indicators, overload protection, timer relays, control relays, drum switches, motor sequence control, reversing motor control, motor jogging, safety interlocks, time-delay relay control.

**EI 429: PLC I Introduction/ Troubleshooting PLCs**

This hands-on course is for students with prior knowledge of electrical motor control and ladder diagrams. The course focuses on constructing, programming, maintaining and troubleshooting of programmable logic controllers (PLCs) and their use in industrial, commercial, and residential applications. **Topics covered:** system design, interfacing to I/O devices, contact and coil instructions, motor control applications, electro-pneumatic applications, BCD/ LED instructions/ applications, program interpretation, PLC system construction, programming, operation, maintenance and troubleshooting.

**EI 432A: Hydraulics**

In this introductory hydraulics course, students complete 16 exercises (activities/problems) that illustrate hydraulic principles and functions of hydraulic components. Students apply basic hydraulic theory in designing, building and testing actual circuits. **Topics covered:** hydraulic power units, pressure relief valves, directional control valves, single and double acting cylinders, cylinder positioning, check and pilot check valves, restrictions to fluid flow, speed control circuits.

**EI 434: Programming/Installing PLC's I**

This course is for students with prior knowledge of PLCs and electrical motor control. Students learn concepts/skills needed to install and maintain a PLC system. **Topics covered:** system layout guidelines, power requirements, safety circuitry, electrical noise in heat problems, I/O installation guidelines and techniques, basic I/O wiring procedures, special interfacing situations, start-up procedures, error faults and troubleshooting, preventative control.

**EI 437: AC Drives, Braking and Starting**

In this course, students study construction, troubleshooting, maintenance, and how to work safely with AC drives, braking and starting motor systems. **Topics covered:** motor plugging, braking, and reduced voltage starting; AC drives, 2-wire control, 3-wire control, manual control, open loop speed control, dynamic braking, programmable acceleration and deceleration, programmed diagnostics, motor jogging, PLC interfacing.

**EI 438: Using and Troubleshooting a PLC System with RSLogix**

This course is for students with knowledge of industrial electricity and controls and who will be responsible for troubleshooting and maintaining SCL 500 systems using RSLogix 500 software. **Topics covered:** system components, Using RSLogix 500 software to: download, save, backup, monitor and enter data; interpreting bit, timer, counter, comparison, data handling and program control instructions; forces, editing, printing.

**EI 439: PLC's II Application Development/PLC Instructions**

This course is for students with prior knowledge of programmable logic controllers (PLCs). The student studies the construction, troubleshooting, maintenance and how to work safely with PLC systems. **Topics covered:** system design, interfacing to I/O devices, instructions (e.g., timer/counter, contact and coil, math, move, subroutine/zone); applications (e.g., motor control, electro-pneumatic); BCD/ LED instructions/applications, program interpretation, PLC programming, operation, troubleshooting; event sequencing, application development.

**EI 441: Basic Robotics**

This course is for students with knowledge of industrial electricity and controls. Students study industrial robotic applications, and sets-up and programs a PC-based five-servo robot for several applications. **Topics covered:** robotic limit switches, servos encoders, resolvers, basic hydraulics, programming fundamentals, basic CNC programming; configuring, programming, and teaching a PC-based robot.

**EI 448A: Troubleshooting Servo Controls**

This course is for students with knowledge of industrial electricity and controls. Students learn about troubleshooting Servo Systems used in industry. It is an advanced level elective course that supplements the student's knowledge as an industrial electronics technician. **Topics covered:** basic Servo operation, DC Servo Motor Control, semiconductor, theory, feedback devices, AC Servo drives.

**EL 101A: Applied Technical Mathematics I**

This course is for students with basic knowledge of arithmetic, fundamental computational skills, and basic algebra skills. Students learn to solve mathematical problems in electricity and electronics. **Topics covered:** decimal numbers and arithmetic functions, negative numbers, fractions, powers and roots, powers of 10, scientific notation, metric conversions, ratio and proportion, trigonometry.

**EL 111: Electric Circuits I**

This course is for beginning students in the Electronics program. The course prepares students prepare to design and troubleshoot series, parallel, and series-parallel circuits. Students also design a loaded voltage divider and a Wheatstone bridge. Students utilize DC theorems in the design process. **Topics covered:** Ohm's law, series, parallel, and complex circuits; bridge circuits, power, network, and theorems.

**EL 114A: Electric Circuits I Lab**

This laboratory course is taken concurrently with EL-111A. Students construct circuits, make measurements, and do troubleshooting. **Topics covered:** proper construction, measurement techniques, troubleshooting of series, parallel, series-parallel, voltage divider, and Wheatstone bridge circuits.

**EL 120A: Applied Technical Mathematics II**

This course is for students with basic knowledge of arithmetic, fundamental computational skills and basic algebra skills. Course follows Tech Math I and provides tools to solve mathematical problems in electronics. **Topics covered:** logarithms, logarithmic graphing literal numbers, multiplying and factoring polynomials, methods of solving equations.

**EL 121: Electric Circuits II**

This course is for students with prior knowledge of DC electronics. This course prepares students to design, construct, measure, and troubleshoot AC circuits as an electronics technician. **Topics covered:** RMS, peak and peak-to-peak AC measurements, reading AC voltages with a DMM and oscilloscope, effects of resistance and reactance in an AC circuit, phase-shift, practical AC power generation practices, capacitance and inductance in an AC circuit, apparent and true power.

**EL 124: Electric Circuits II Lab**

This lab is taken concurrently with EL-121. Students **design, construct, measure and troubleshoot AC circuits. Topics covered:** operation of the sine-square wave generator, operation of the oscilloscope, construction, operation, troubleshooting AC circuits; verification of proper circuit operation using the DMM and oscilloscope.

**EL 130: Semiconductor Devices**

This is a theory course for students with basic knowledge of DC and AC electronics. The course is taken concurrently with EL 132 and provides the foundation for semiconductor devices that are used in electronics. **Topics covered:** semiconductors, diodes, power supplies, junction transistors, and electronic control devices.

**EL 131: Semiconductor Devices Lab**

This is a hands-on lab for students with basic knowledge of DC and AC electronics. Students apply the theory learned in EL-130. in lab exercises and projects. Students test and troubleshoot semiconductor devices used in electronics. **Topics covered:** semiconductors, diodes, power supplies, junction transistors, electronic control devices.

**EL 132A: Electronic Circuits**

This is a theory course for students with basic knowledge of semiconductors. Students learn the foundation for circuits that are used in electronics. This course is taken concurrently with EL-134A.. **Topics covered:** small and large signal amplifiers, operational amplifiers, regulated power supplies and oscillators.

**EL 134A: Electronic Circuits Lab**

This is a hands-on lab for students with basic knowledge of semiconductors. Student apply the theory learned in EL 132A in lab exercises and projects related to electronic circuits. **Topics covered:** small and large signal amplifiers, operational amplifiers, regulated power supplies and oscillators.

**EL 143A: Digital Circuits and Intro to Microprocessors**

This course is for advanced students with prior knowledge of semiconductor circuits. Students build, program and troubleshoot digital circuits and microprocessor systems related to the telecommunication field. **Topics covered:** digital arithmetic, digital logic (Boolean), synchronous and asynchronous digital circuits, 8086-based microprocessor logic and programming, and PC systems hardware and software integration.

**EL 160: Cabling Technology**

This course is for students with knowledge of basic electricity and controls. Students learn the fundamental knowledge, understanding, and skills needed to install, troubleshoot, and maintain cable and low voltage wiring systems. The course provides students with the foundation to become qualified cable technicians or enhances their employability as an industrial or telecommunications technician. **Topics covered:** network theory and components, cable installation, termination, and testing.

**ES 115 Basic Electronic systems**

This course is for students who have a basic understanding of cabling. This class builds on the student's basic cabling skills and knowledge. Students develop competency in basic cabling installation, testing, and troubleshooting a network.

**Topics covered:** Networking, structured wiring, measuring data throughput, blueprint symbols, telecommunication connections and wall outlets, PBX and Key systems, data transmission, troubleshooting telecommunications systems.

**ES 116: Audio-Video Systems**

This course is for students who already have basic cabling and electronic systems integration skills. This course provides students with the necessary tools for grasping the complex technologies of home automation and prepares students to take the Electronic Technology Associations' RESI Audio and Video Certification Exam. **Topics covered:** Audio/video basics and components, audio speaker and video speaker design, analog and digital television broadcast standard, audio/video system formats and connections, residential home theater systems, multi-room audio systems.

**ES 117 Electronic Systems Project**

This course is for students who already have basic cabling and electronic systems integration skills and who want/need to build experience, knowledge or proficiency. The student will apply all knowledge/skills gained from Cabling, Basic Electronic Systems, and Audio-Video Systems through hands-on projects. Topics covered: Projects are individualized based on student need and interest.