

Industrial Electronics Curriculum Guide 2023-2024

Program Description

Students learn to operate, troubleshoot, repair, and maintain equipment in an industrial/manufacturing setting. Students learn a combination of theory and hands-on skills in AC/DC electronics, power distribution, control panel wiring, mechanical systems, fluid power, automation and controls, manufacturing machines and troubleshooting. Students may train for industry certificates from Manufacturing Skills Institute (MSI) to earn a Manufacturing Technician, Manufacturing Specialist, and/or Business certificate.

Program Admissions Requirements - Students who most closely match the **U.S. Department of Labor occupational profile** for the first exit point of an Assembly Worker.

CASAS Scaled Scores - Reading & Math 228+

Aptitudes

- General Learning (G) CareerScope: 80+
- Verbal (V) CareerScope: 80+
- Numerical (N) CareerScope: 80+
- Spatial (S) CareerScope: 80+
- Motor Coordination (K) Career Scope: 80+
- Finger Dexterity (F) CareerScope: 80+
- Manual Dexterity (M) CareerScope: 80+

Temperaments

- Attain precise limits and standards using precision measuring instruments, prepare detailed records, and comply with precise specifications.
- Perform a variety of duties involving different equipment and procedures. Complete tasks without loss of efficiency or composure.

Physical Demands & Work Environment -Minimum Physical Requirements can be found on the Curriculum Guide online at www.michigan.gov/MCTI.

Certificate of Completion Programs:

- Assembler (51-2022: Electrical and Electronic Equipment Assemblers)
- Industrial Electronic Mechanic (49-2094: Electrical and Electronics Repairers)
- Manufacturing Technician (51-9199: Production Workers, All Other)

Students may be in the Industrial Electronics program for up to four terms. At the end of each term, the instructor invites students who demonstrate academic progress by maintaining an accumulated grade point average of 2.0 or better and good employability skills to advance to the next term.

Required Courses

To advance from term to term, students must demonstrate academic progress (satisfactory grade point average of 2.0) and good employability skills.

Assembler/Tester (two terms)

Course Number	Course Name	Credits
EL 101A	Applied Technical Math 1	2
EL 111A	Electric Circuits 1	6
EL 112A	Introduction to Manufacturing Basics	4
EL 120C	Applied Technical Mathematics II	2
EL 121	Electric Circuits II	4
EL 125	Intro to Manufacturing Machines	2
EI 411	Mechanical Drive Systems I	4

Industrial Tester/Installer (one term)

Course Number	Course Name	Credits
EI 412B	Pneumatics Fundamentals & Electro Pneumatics	6
EI 415	Power Distribution Systems	4
EL 416	Manufacturing Skills Institute Studies	2

Industrial Electronics Technician (one term)

Course Number	Course Name	Credits
EI 417A	Electrical Motor Control 1	2
EI 427	Electrical Motor Control II	4
EI 429A	PLC I Introduction/ Troubleshooting PLCs	3
EI 437A	AC Drives, Braking and Starting	3

Electives (Instructor Approval Needed)

Course Number	Course Name	Credits
EL 413	Rotating Electrical Machines	4
EL 421	Mechanical Drives II	4
EI 432A	Hydraulics	4
EI 439	PLCs II Application Development & PLC Instructions	4

Advanced Courses (Instructor Approval Needed)

Course Number	Course Name	Credits
EL 680	Independent Study	2-12
EL 690	Work Internship	6-12

Instructors, program managers, and/or the referring counselor may recommend employability skills and elective classes based on the student’s needs, interest, and abilities. Additional terms or courses are initiated by the instructor and approved by the Manager of Career and Technical Education programs. Job Seeking Skills is required for all students expecting to graduate from MCTI.

Course Descriptions

EL 101A Applied Technical Mathematics 1 - This course is for students with basic knowledge of arithmetic, fundamental computational skills, percentage, and basic algebra skills. Students learn to solve mathematical problems as they relate to 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 and series, parallel and combination circuit calculations. It also covers geometry, linear equations, and basic right triangle trigonometry. Emphasis is on problem solving with specific applications designed to interface with the student's core program. Cooperative learning activities and technology are used to support learning.

EL 111A Electric Circuits 1 - This course is designed to introduce students to two of the fundamentals of the Industrial Electronics program, Basic Electricity and Electrical Controls. The course teaches fundamentals of AC/DC electrical systems used for power and control in manufacturing and industry. **Topics Covered:** Basic electrical circuits, electrical measurement, circuit analysis, additional concepts include electro-pneumatic solenoid valves; sequencing control including relay operation, relay application, limit switch operation and application.

EL 112A Introduction to Manufacturing Basics – This course is designed to introduce students to the basic knowledge needed for assembly in a manufacturing environment. The focus is on the proper and safe application of hand tools, knowledge

in the many types of bolts, wrenches and other fittings commonly used in industry and how to properly apply them, including pneumatic fabrication fittings. The course focuses on proper techniques for checking connections and testing fittings with an emphasis on safety. **Topics Covered:** Threaded Fasteners, Wrenches, Pneumatic System Fabrication, Screwdrivers, Pliers and Locking Devices, Mallets and Non-Threaded Fasteners, Torque Wrenches, and Portable Power Tools.

EL 120C Applied Technical Mathematics II - This course is for students who have successfully completed **EL 101A** and who understand and are proficient using basic decimal and arithmetic computational skills, and basic algebra skills to solve more complex calculations. Course follows Tech Math I and provides tools to solve mathematical problems in electronics. **Topics Covered:** logarithms, logarithmic graphing, **Algebra:** literal numbers, multiplying and factoring polynomials, methods of solving equations, binary conversions and binary truth tables and the design and calculations to solve complex series, parallel and combination circuits.

EL 121 Electric Circuits II - This course builds on the theory learned and practical application of basic electricity learned in EL 111A on the AC/DC trainer. This course prepares students to troubleshoot AC circuits as an electronics technician. **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. 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, transformers, apparent and true power. (Prerequisites: EL 111A)

EL 125 Intro to Manufacturing Machines – In this course students will learn the basics of manufacturing machines and some of the tools used in a manufacturing setting. Robotics and Computer Programming discusses the basic operation of a robot. CNC Machines introduces students to programming by describing the functions and operations of a CNC Mill and discussing CNC Mill programming, simulation, and safety. Students begin to learn basic CNC Mill programming, linear interpolation, start-up and shutdown blocks, tooling selection, and locating zero is discussed and skills are applied to move to Circular Interpolation. Measurement Tools introduces basic measurement, precision measurement tools, and dimensional gauging.

Topics Covered: safety, powerup, shutdown, manual operation, homing, end effector operation. Skills taught also include basic robot programming including movement and effector commands, interfacing and material handling, circular interpolation will cover absolute and incremental positioning, program interpolation, program interpretation and

pausing CNC programs. Signal integrity (SI) set of measurement, Measurement, U.S. Customary Measurements, Tape Measure and Measurement Conversion. Applications taught include using a dial caliper, digital caliper, English micrometer, and metric micrometer. Dimensional Gauging will include an introduction to gauging as well as indicator measurement and data collection.

EI 411 Mechanical Drive Systems 1 - 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 412A Pneumatics Fundamentals & Electro Pneumatics - In this course, students will be introduced to the design, construction, maintenance and troubleshooting of pneumatics and electro-pneumatics systems. Industry safety standards are emphasized. Electro-Fluid Power introduces electrical control systems and discusses basic control devices, power devices, control relays, sequencing control, timer control, pressure control applications, and circuit applications. Also discussed in depth to provide further skills is automatic and electrical control concepts and devices, logic elements, hydraulic and pneumatics solenoid-operated valves, relay and motor control applications, safety circuits and modes of operation.

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. Also, 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, and/or logic functions, flow control, quick exhaust, sequence valve, pressure regulator, pneumatic timer, coordinated motion control.

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. Students are introduced to electrical system wiring and developing fundamental knowledge of electrical wiring and components. Covers basic electrical system wiring, control panels, interpreting wire installation plans, handling

non-metallic cable, understanding application of basic components such as switches, outlets, and lighting, and connecting electrical services. 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 417A Electrical Motor Control 1 - 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 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:** Topics include voltage testing equipment, control component troubleshooting, motor starter troubleshooting, power component troubleshooting, troubleshooting methods, systems troubleshooting, and troubleshooting motor control circuits, 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 429A 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 437A 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 413 Rotating Electrical Machines – This is an introductory course in electric motors, covering electric motor construction, troubleshooting, maintenance, and safety. Students learn how to operate, install, analyze performance, and select electric motors 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.

EL 421 Mechanical Drives Systems II – COURSE DESCRIPTION/PURPOSE: This course is designed for students who have already been exposed to the entry level course Mechanical Drives I. This is a highly interactive course which prepares individuals for entry-level employment entering the field of Industrial Electronics Maintenance. 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 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 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.