

**Florida Department of Education
Curriculum Framework**

Program Title: Electrical and Instrumentation Technology 1
Program Type: Career Preparatory
Career Cluster: Manufacturing

Career Certificate Program – Career Preparatory

Program Number	J110100
CIP Number	0615040401
Grade Level	30, 31
Standard Length	1000 hours
Teacher Certification	Refer to the Program Structure section
CTSO	SkillsUSA
SOC Codes (all applicable)	47-2111 – Electricians 49-2094 – Electrical and Electronics Repairers, Commercial and Industrial Equipment
CTE Program Resources	http://www.fldoe.org/academics/career-adult-edu/career-tech-edu/program-resources.stml
Basic Skills Level	Mathematics: 11 Language: 10 Reading: 10

Purpose

This program offers a sequence of courses that provides coherent and rigorous content aligned with challenging academic standards and relevant technical knowledge and skills needed to prepare for further education and careers in the manufacturing career cluster; provides technical skill proficiency, and includes competency-based applied learning that contributes to the academic knowledge, higher-order reasoning and problem-solving skills, work attitudes, general employability skills, technical skills, and occupation-specific skills, and knowledge of all aspects of the manufacturing career cluster.

The content includes but is not limited to communication skills, leadership skills, human relations and employability skills, safe and efficient work practices, and the technical training to support professional personnel in the engineering, design, development and evaluation of electrical and instrument systems.

Additional Information relevant to this Career and Technical Education (CTE) program is provided at the end of this document.

Program Structure

This program is a planned sequence of instruction consisting of three occupational completion points.

This program is comprised of courses which have been assigned course numbers in the SCNS (Statewide Course Numbering System) in accordance with Section 1007.24 (1), F.S. Career and Technical credit shall be awarded to the student on a transcript in accordance with Section 1001.44 (3)(b), F.S.

To teach the course(s) listed below, instructors must hold at least one of the teacher certifications indicated for that course.

The following table illustrates the postsecondary program structure:

OCP	Course Number	Course Title	Teacher Certification	Length	SOC Code
A	EEV0650	Electrician (Construction)	ELECTRONIC @7 7G TEC ELEC @7 7G	350 hours	47-2111
B	EEV0652	Instrument Mechanic		350 hours	49-2094
C	EEV0654	Electrician Maintenance		300 hours	47-2111

Common Career Technical Core – Career Ready Practices

Career Ready Practices describe the career-ready skills that educators should seek to develop in their students. These practices are not exclusive to a Career Pathway, program of study, discipline or level of education. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study.

1. Act as a responsible and contributing citizen and employee.
2. Apply appropriate academic and technical skills.
3. Attend to personal health and financial well-being.
4. Communicate clearly, effectively and with reason.
5. Consider the environmental, social and economic impacts of decisions.
6. Demonstrate creativity and innovation.
7. Employ valid and reliable research strategies.
8. Utilize critical thinking to make sense of problems and persevere in solving them.
9. Model integrity, ethical leadership and effective management.
10. Plan education and career path aligned to personal goals.
11. Use technology to enhance productivity.
12. Work productively in teams while using cultural/global competence.

Standards

After successfully completing this program, the student will be able to perform the following:

- 01.0 Demonstrate knowledge of National Electrical Codes (NEC).
- 02.0 Install and troubleshoot facility electrical circuits from service entrance to convenience outlets.
- 03.0 Demonstrate knowledge of using basic electrical drawings.
- 04.0 Demonstrate basic electrical construction skills.
- 05.0 Demonstrate understanding of DC power sources.
- 06.0 Demonstrate understanding of AC power sources.
- 07.0 Demonstrate knowledge of DC motors.
- 08.0 Demonstrate knowledge of AC motors.
- 09.0 Demonstrate knowledge of motor controls.
- 10.0 Demonstrate knowledge of transformers.
- 11.0 Demonstrate knowledge of over current protection and grounding.
- 12.0 Demonstrate knowledge of an industrial power distribution system.
- 13.0 Perform preventive and corrective maintenance on basic electrical power and control components.
- 14.0 Demonstrate knowledge of electrical test equipment.
- 15.0 Demonstrate knowledge of hydraulic and pneumatic systems.
- 16.0 Identify the basic principles and terminology of process control.
- 17.0 Identify the primary components of a process control system.
- 18.0 Demonstrate knowledge of using instrumentation drawings.
- 19.0 Demonstrate knowledge of using instrumentation test instruments.
- 20.0 Demonstrate knowledge of instrumentation installation techniques.
- 21.0 Demonstrate knowledge of programmable logic controllers (PLC).

**Florida Department of Education
Student Performance Standards**

Program Title: Electrical and Instrumentation Technology 1
Career Certificate Program Number: J110100

Course Number: EEV0650
Occupational Completion Point: A
Electrician (Construction) – 350 Hours – SOC Code 47-2111

Course Description:

The Electrician (Construction) course prepares students for entry into the Electrical and Instrumentation Technology industry. Students explore career opportunities and requirements of a professional electrical and instrumentation technician. Content emphasizes beginning skills key to the success of working in the Electrical and Instrumentation industry. Students study the National Electrical Code, installation and troubleshooting of facility wiring circuits, basic electrical drawings, electrical construction skills, DC and AC power systems, DC and AC motors, motor controls, transformers, over-current and grounding, industrial power distribution systems, preventative and corrective maintenance, electrical testing equipment, and hydraulic and pneumatic systems.

CTE Standards and Benchmarks	
01.0	Demonstrate knowledge of the National Electrical Code (NEC).--The student will be able to:
01.01	Relate the NEC to general wiring practices.
01.02	Relate the NEC to wire, conduit and box sizing.
01.03	Relate the NEC to outlets, lighting, appliances and building services.
01.04	Relate the NEC to services and service calculations.
01.05	Relate the NEC to grounding and bonding requirements.
01.06	Relate the NEC to over current protection.
01.07	Relate the NEC to motor circuit wiring.
01.08	Relate the NEC to transformers.
01.09	Relate the NEC to hazardous location wiring.
01.10	Relate the NEC to emergency and alternate power systems.
01.11	Relate the NEC to industrial electrical.
02.0	Install and troubleshoot facility wiring circuits from service entrance to convenience outlets.--The student will be able to:
02.01	Demonstrate the knowledge power requirements, distribution, and construction considerations to meet the needs for a safe and functional electrical system for residential, commercial, or industrial facilities.

CTE Standards and Benchmarks	
02.02	Determine the size of service entrance equipment, components and conductors.
02.03	Demonstrate proper methods to install service entrance, lighting circuits and equipment branch circuits.
02.04	Demonstrate knowledge of NEC local codes, utility regulations, special ordinances and installation instructions.
02.05	Demonstrate knowledge of optional electrical safety devices, special fixtures (explosion proof, waterproof), communications and alarm systems, timers and controllers.
02.06	Demonstrate knowledge of the needs for, and the proper methods of facility grounding systems.
02.07	Demonstrate the ability to troubleshoot faults in control and power circuits.
02.08	Choose the correct test equipment to service electrical systems.
03.0	Demonstrate knowledge of using basic electrical drawings.--The student will be able to:
03.01	Demonstrate the knowledge to describe, identify and use electrical symbols and abbreviations.
03.02	Demonstrate the knowledge to use floor plans, lighting layouts and building service drawings.
03.03	Demonstrate the knowledge to use single line power distribution drawings.
03.04	Demonstrate the knowledge to use elementary drawings.
03.05	Demonstrate the knowledge to use process logic drawings.
03.06	Demonstrate the knowledge to convert English system and metric system measurements.
03.07	Demonstrate the knowledge to use measuring scales to take accurate system measurements.
03.08	Demonstrate the knowledge to produce accurate electrical drawings.
03.09	Demonstrate the knowledge to prepare an equipment and material list.
03.10	Demonstrate the knowledge to troubleshoot using the different electrical diagrams and drawings.
04.0	Demonstrate basic electrical construction skills.--The student will be able to:
04.01	Use blueprints and associated documents to identify materials and equipment which will be needed to perform construction or maintenance task.
04.02	Use the proper equipment to make correct and accurate bends in various types of electrical conduits.
04.03	Use the proper equipment to thread electrical conduit.
04.04	Make appropriate electrical terminations.
04.05	Apply correct wiring methods to motors and motor control circuits.
04.06	Apply correct wiring methods to transformers.
04.07	Install non-metallic sheathed cable.

CTE Standards and Benchmarks	
04.08	Correctly install lighting fixtures and perform preventive and corrective maintenance.
04.09	Correctly install switching and outlet devices.
04.10	Correctly use power tools.
05.0	Demonstrate an understanding of DC power sources.--The student will be able to:
05.01	Describe safe procedures for handling, storing, charging and installing storage batteries.
05.02	Describe electrical characteristics of lead-acid storage batteries, dry cell and NiCd.
05.03	Demonstrate knowledge of low voltage electronic power supplies.
05.04	Demonstrate knowledge of DC generator theory and construction for DC generators.
05.05	Perform troubleshooting and preventive maintenance on DC power sources.
06.0	Demonstrate and understanding of AC power sources.--The student will be able to:
06.01	Calculate and explain power factor.
06.02	Calculate and explain power factor corrections.
06.03	Demonstrate knowledge of the theory and physical and electrical characteristics of three phase alternators.
06.04	Demonstrate knowledge of the theory and application for engine driven generating sets, including types of prime movers and transfer switches.
06.05	Demonstrate knowledge of paralleling, synchronizing, testing three phase alternators.
06.06	Demonstrate knowledge of selecting, troubleshooting, connecting and maintaining 3-phase alternators.
06.07	Demonstrate knowledge of uninterruptible power supplies (UPS).
07.0	Demonstrate knowledge of DC motors.--The student will be able to:
07.01	Demonstrate knowledge of DC motor theory and construction including series, shunt and compound motors.
07.02	Demonstrate knowledge of DC motor torque effectively speed regulation, loading and starting.
07.03	Demonstrate knowledge of performing maintenance procedures for and installation of DC motors.
07.04	Demonstrate knowledge of correctly apply testing and monitoring equipment to DC motors and machines.
07.05	Select and apply DC motor controls.
08.0	Demonstrate knowledge of AC motors.--The student will be able to:
08.01	Demonstrate knowledge of single-phase AC motors.
08.02	Demonstrate the ability to select connect and troubleshoot single phase AC motors.

CTE Standards and Benchmarks	
08.03	Demonstrate knowledge of 3-phase AC motors.
08.04	Demonstrate the ability to select, connect, troubleshoot and maintain 3-phase AC motors.
08.05	Demonstrate the ability to correctly apply testing and monitoring equipment to AC 3-phase motors.
08.06	Select and apply AC motor controls.
08.07	Disassemble and assemble a single-phase motor.
08.08	Disassemble and assemble a 3-phase motor.
08.09	Perform preventative maintenance for AC motors.
09.0	Demonstrate knowledge of motor controls.--The student will be able to:
09.01	Use schematics and drawings to troubleshoot electrical failures.
09.02	Demonstrate knowledge of motor starters.
09.03	Design, install, operate, and troubleshoot 2-wire control.
09.04	Design, install, operate, and troubleshoot 3-wire control.
09.05	Design, install, operate, and troubleshoot motor control circuits that use timers.
09.06	Design, install, operate, and troubleshoot motor control circuits that use relays.
09.07	Design, install, operate, and troubleshoot motor control circuits that use sequences.
09.08	Demonstrate the ability to install and troubleshoot limit switches, proximity switches and other sensors in control circuits.
09.09	Demonstrate knowledge of variable frequency drives (VFC's).
09.10	Demonstrate knowledge of DC motor circuits.
10.0	Demonstrate knowledge of transformers.--The student will be able to:
10.01	Demonstrate knowledge of transformer theory and application.
10.02	Demonstrate knowledge of single-phase transformer theory and application.
10.03	Demonstrate knowledge of theory and application of a single-phase 3-wire secondary system.
10.04	Demonstrate knowledge of theory and application for single-phase transformers connected in 3-phase systems.
10.05	Apply testing and monitoring equipment to transformers and their associated circuits.
10.06	Install transformers to primary service and main switch metering equipment and secondary switching.
10.07	Install transformer over current protection.
11.0	Demonstrate knowledge of over current protection and grounding.--The student will be able to:

CTE Standards and Benchmarks	
11.01	List and identify types, classes and ratings of fuses and circuit breakers.
11.02	Describe operation of fuses and breakers.
11.03	Install fuses and breakers.
11.04	Select and apply branch-circuit protection for appliances.
11.05	Select and apply branch-circuit and overload protection for motors.
11.06	Relate the NEC to the selection and installation of over current protection devices.
11.07	Explain the purpose of equipment grounding.
11.08	Relate the NEC to the sizing and installation of grounding systems and conductors.
11.09	Perform preventative maintenance on grounding systems.
12.0	Demonstrate knowledge of an industrial power distribution system.--The student will be able to:
12.01	Demonstrate knowledge of a utility generation and distribution system.
12.02	Demonstrate knowledge of a typical industrial generation and distribution system.
12.03	Demonstrate knowledge of co-generation applications.
12.04	Demonstrate knowledge of protective relay applications.
12.05	Demonstrate knowledge of amperage, voltage control and power factor control techniques.
12.06	Demonstrate knowledge of breaker controls and computer load shed considerations.
12.07	Demonstrate knowledge of high voltage, distribution equipment, ground fault protection methods.
12.08	Demonstrate knowledge of safety procedures including identification of equipment used for testing high voltage.
12.09	Demonstrate knowledge of pole line isolation switches.
12.10	Demonstrate knowledge of current transformers (CT's) and potential transformers (PT's).
13.0	Perform preventative and corrective maintenance on basic electrical power and control components.--The student will be able to:
13.01	Use technical data and manuals to perform preventative maintenance.
13.02	Demonstrate ability to select and apply appropriate tools and testing equipment.
13.03	Perform corrective preventative maintenance and certify completion.
13.04	Determine the need for corrective maintenance by applying trouble-shooting and analysis techniques.
13.05	Replace parts and calibrate or adjust as necessary to bring equipment, systems, components or machines to specifications.
13.06	Prepare forms and reports of preventive and corrective maintenance.

CTE Standards and Benchmarks	
14.0	Demonstrate knowledge of electrical test equipment.--The student will be able to:
14.01	Demonstrate the ability to use an analog multi-meter.
14.02	Demonstrate the ability to use a digital multi-meter.
14.03	Demonstrate the ability to use a “wiggy” voltmeter.
14.04	Demonstrate the ability to use a clamp-on ammeter.
14.05	Demonstrate the ability to use a megohmmeter.
14.06	Demonstrate the ability to use an oscilloscope.
14.07	Demonstrate the ability to use a high voltage tester.
14.08	Use test equipment to systematically troubleshoot a defective system.
15.0	Demonstrate knowledge of hydraulic and pneumatic systems.--The student will be able to:
15.01	Identify principles and practical applications of hydraulic and pneumatic power.
15.02	Identify control valves in a hydraulic and pneumatic system.
15.03	Identify pressure and safety relief valves and vacuum breakers.
15.04	Identify cylinders and motors.
15.05	Remove and replace hydraulic and pneumatic systems and components.
15.06	Identify strainers and filters in hydraulic and pneumatic systems.
15.07	Identify reservoirs and accumulators in hydraulic and pneumatic systems.
15.08	Identify hydraulic and pneumatic pimps on a system.
15.09	Identify piping, tubing, and fittings on a hydraulic pneumatic system.
15.10	Identify system interfaces.
15.11	Identify the procedures for pneumatic and hydraulic system maintenance.
15.12	Locate control valve failures.
15.13	Demonstrate knowledge of regulators, volume boosters, relays and repeaters.
15.14	Identify the components to produce instrument air.
15.15	Demonstrate knowledge of current-to-pressure and pressure-to-current transducers.

**Florida Department of Education
Student Performance Standards**

Course Number: EEV0652

Occupational Completion Point: B

Instrument Mechanics – 350 Hours – SOC Code 49-2094

Course Description:

The Instrumentation Mechanics course is designed to build on the skills and knowledge students learned in the Electrician (Construction) course for entry into the Electrical and Instrumentation Technology industry. Students explore career opportunities and requirements of a professional electrical and instrumentation technician. Content emphasizes beginning skills key to the success of working in the Electrical and Instrumentation industry. Students study basic principles, terminology, and components of process control, instrumentation drawings, testing equipment, and installation techniques.

CTE Standards and Benchmarks	
16.0	Identify the basic principles and terminology of process control.--The student will be able to:
16.01	Identify the purpose of automatic control systems.
16.02	Identify the elements of process control.
16.03	Identify measured and manipulated variables in a control loop.
16.04	Demonstrate knowledge of proportional control.
16.05	Demonstrate knowledge of on/off control.
16.06	Determine the effects of gain, reset and derivative in a proportional control scheme.
16.07	Demonstrate knowledge of the basic laws of physics pertaining to instrumentation.
16.08	Demonstrate knowledge of the terminology associated with instrumentation and process control.
17.0	Identify the primary components of a process control system.--The student will be able to:
17.01	Identify primary control elements in process loops.
17.02	Identify final control elements in process loops.
17.03	Identify electronic, pneumatic, and digital transmitters in process loops.
17.04	Identify controllers in process loops.
17.05	Identify control loop applications (level, flow, temp, pressure, or analytical).
17.06	Define the static and dynamic characteristics of instruments.
17.07	Demonstrate knowledge necessary to interface individual process loops into microprocessor based control schemes.

CTE Standards and Benchmarks

18.0 Demonstrate knowledge of using instrumentation drawings.--The student will be able to:

- 18.01 Demonstrate ability to use loop sheets.
- 18.02 Demonstrate ability to use flow sheets/P&IDs.
- 18.03 Demonstrate ability to use process logic diagrams.
- 18.04 Demonstrate ability to use installation drawings.
- 18.05 Demonstrate ability to use building layout or location drawings.
- 18.06 Troubleshoot using drawings.
- 18.07 Identify process safety devices and explain their purpose.

19.0 Demonstrate knowledge of using instrumentation test instruments.--The student will be able to:

- 19.01 Operate basic hydraulic measuring instruments.
- 19.02 Operate dead weight testers.
- 19.03 Operate manometers.
- 19.04 Operate basic pneumatic measuring instruments.
- 19.05 Operate vacuum pumps.
- 19.06 Operate pressure and vacuum gauges.
- 19.07 Operate basic thermal measuring instruments.
- 19.08 Operate temperature baths.
- 19.09 Operate electronic calibration instruments.
- 19.10 Operate thermometers.
- 19.11 Calibrate instruments using test instruments.
- 19.12 Operate instrument standards.

20.0 Demonstrate knowledge of instrumentation installation techniques.--The student will be able to:

- 20.01 Apply proper OSHA safety standards.
- 20.02 Make electrical connections for instrument equipment.
- 20.03 Identify and use hand tools properly.
- 20.04 Identify and use power tools properly.
- 20.05 Demonstrate acceptable tubing bending and installation techniques.

CTE Standards and Benchmarks

20.06 Identify the proper method for instrument wire installation in a cable tray.

20.07 Demonstrate the ability to properly install various instrumentation devices.

20.08 Demonstrate knowledge of “clean design” for instrument installations.

**Florida Department of Education
Student Performance Standards**

Course Number: EEV0654

Occupational Completion Point: C

Electrician Maintenance – 300 Hours – SOC Code 47-2111

Course Description:

The Electrician Maintenance course is designed to build on the skills and knowledge students learned in the Instrumentation Mechanics course for entry into the Electrical and Instrumentation Technology industry. Students explore career opportunities and requirements of a professional electrical and instrumentation technician. Content emphasizes beginning skills key to the success of working in the Electrical and Instrumentation industry. Students study programmable logic controllers (PLC).

CTE Standards and Benchmarks	
21.0	Demonstrate knowledge of programmable logic controllers (PLC).--The student will be able to:
21.01	Demonstrate knowledge of the terminology and operating components of PLC systems.
21.02	Demonstrate knowledge of the addressing schemes used in various PLC systems.
21.03	Understand and use ladder logic for various PLC systems.
21.04	Program basic relay logic in ladder logic.
21.05	Program timers and counters in ladder logic.
21.06	Program shift registers and other data manipulation routines.
21.07	Program for message displays and other output devices.
21.08	Interface PLS's to perform communications.
21.09	Load and save files on storage media.
21.10	Prepare and update documentation.
21.11	Perform local/remote interfacing.
21.12	Troubleshoot defective PLC systems.

Additional Information

Laboratory Activities

Laboratory investigations that include scientific inquiry, research, measurement, problem solving, emerging technologies, tools and equipment, as well as, experimental, quality, and safety procedures are an integral part of this career and technical program/course. Laboratory investigations benefit all students by developing an understanding of the complexity and ambiguity of empirical work, as well as the skills required to manage, operate, calibrate and troubleshoot equipment/tools used to make observations. Students understand measurement error; and have the skills to aggregate, interpret, and present the resulting data. Equipment and supplies should be provided to enhance hands-on experiences for students.

Special Notes

MyCareerShines is an interactive resource to assist students in identifying their ideal career and to enhance preparation for employment. Teachers are encouraged to integrate this resource into the program curriculum to meet the employability goals for each student. Access MyCareerShines by visiting: www.mycareershines.org.

Career and Technical Student Organization (CTSO)

SkillsUSA is the intercurricular career and technical student organization(s) providing leadership training and reinforcing specific career and technical skills. Career and Technical Student Organizations provide activities for students as an integral part of the instruction offered.

Cooperative Training – OJT

On-the-job training is appropriate but not required for this program. Whenever offered, the rules, guidelines, and requirements specified in the OJT framework apply.

Basic Skills

In a Career Certificate Program offered for 450 hours or more, in accordance with Rule 6A-10.040, F.A.C., the minimum basic skills grade levels required for postsecondary adult career and technical students to complete this program are: Mathematics 11.0, Language 10.0, and Reading 10.0. These grade level numbers correspond to a grade equivalent score obtained on a state designated basic skills examination.

Adult students with disabilities, as defined in Section 1004.02(7), Florida Statutes, may be exempted from meeting the Basic Skills requirements (Rule 6A-10.040). Students served in exceptional student education (except gifted) as defined in s. 1003.01(3)(a), F.S., may also be exempted from meeting the Basic Skills requirement. Each school district and Florida College must adopt a policy addressing procedures for exempting eligible students with disabilities from the Basic Skills requirement as permitted in Section 1004.91(3), F.S.

Students who possess a college degree at the Associate of Applied Science level or higher; who have completed or are exempt from the college entry-level examination; or who have passed a state, national, or industry licensure exam are exempt from meeting the Basic Skills requirement (Rule 6A-10.040, F.A.C.) Exemptions from state, national or industry licensure are limited to the certifications listed on the Basic Skills and Licensure Exemption List which may be accessed from the CTE Program Resources page.

Accommodations

Federal and state legislation requires the provision of accommodations for students with disabilities to meet individual needs and ensure equal access. Postsecondary students with disabilities must self-identify, present documentation, request accommodations if needed, and develop a plan with their counselor and/or instructors. Accommodations received in postsecondary education may differ from those received in secondary education. Accommodations change the way the student is instructed. Students with disabilities may need accommodations in such areas as instructional methods and materials, assignments and assessments, time demands and schedules, learning environment, assistive technology and special communication systems. Documentation of the accommodations requested and provided should be maintained in a confidential file.

Note: postsecondary curriculum and regulated secondary programs cannot be modified.

Additional Resources

For additional information regarding articulation agreements, Bright Futures Scholarships, Fine Arts/Practical Arts Credit and Equivalent Mathematics and Equally Rigorous Science Courses please refer to:

<http://www.fldoe.org/academics/career-adult-edu/career-tech-edu/program-resources.stml>