2024 Electrical

Program CIP46.0302 - Electrician

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The Research and Curriculum Unit (RCU), located in Starkville, as part of Mississippi State University (MSU), was established to foster educational enhancements and innovations. In keeping with the land-grant mission of MSU, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Acknowledgments

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Dr. Ray Morgigno, interim state superintendent of education, executive secretary
Mr. Glen V. East, chair
Mr. Matt Miller, vice chair
Dr. Ronnie L. McGehee
Mr. Bill Jacobs
Mr. Mike Pruitt
Mrs. Mary Werner
Dr. Wendi Barrett
Mr. Charlie Frugé, student representative
Ms. Kate Riddle, student representative

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Standards

Standards and alignment crosswalks are referenced in the appendix. Depending on the curriculum, these crosswalks should identify alignment to the standards mentioned below, as well as possible related academic topics as required in the Subject Area Testing Program in Algebra I, Biology I, English II, and U.S. History from 1877, which could be integrated into the content of the units. Mississippi's CTE electrical is aligned to the following standards:

National Center for Construction Education and Research (NCCER) Learning Series Electrical Standards
The NCCER developed and published a set of industry standards that are taught nationwide by contractors, associations, construction users, and secondary and postsecondary schools called the NCCER Learning Series. When developing this set of standards, the NCCER assembled a team of subject matter experts that represented construction companies and schools across the nation. Each committee met several times and combined experts' knowledge and experience to finalize the set of national industry standards.

International Society for Technology in Education Standards (ISTE)

iste.org

College- and Career-Ready Standards
College- and career-readiness standards emphasize critical thinking, teamwork, and problem-solving skills. Students will learn the skills and abilities required by the workforce of today and the future. Mississippi adopted Mississippi College- and Career-Readiness Standards (MCCRS) to provide a consistent, clear understanding of what students are expected to learn so teachers and parents know what they need to do to help them.
mdek12.org/oae/college-and-career-readiness-standards

Framework for 21st–Century Learning
In defining 21st–century learning, the Partnership for 21st–Century Skills has embraced key themes and skill areas that represent the essential knowledge for the 21st century: global awareness; financial, economic, business, and entrepreneurial literacy; civic literacy; health literacy; environmental literacy; learning and innovation skills; information, media, technology skills; and life and career skills. *Framework for 21st–Century Learning Definitions* (2019).
battelleforkids.org/networks/p21/frameworks-resources

Preface

Secondary CTE programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing applied learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments. This document provides information, tools, and solutions that will aid students, teachers, and schools in creating and implementing applied, interactive, and innovative lessons. Through best practices, alignment with national standards and certifications, community partnerships, and a hands-on, student-centered concept, educators will be able to truly engage students in meaningful and collaborative learning opportunities.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Strengthening Career and Technical Education for the 21st Century Act, 2019 [Perkins V]; and Every Student Succeeds Act, 2015).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers:

Curriculum, Assessment, Professional Learning
: Program resources can be found at the RCU's website, rcu.msstate.edu.

Learning Management System: An Online Resource
: Learning management system information can be found at the RCU's website, under Professional Learning.

Should you need additional instructions, call the RCU at 662.325.2510 or helpdesk@rcu.msstate.edu.

Executive Summary

Pathway Description

The Architecture and Construction Career Cluster includes a specialized pathway in Electrical studies. This program equips individuals for careers or further education in the electrical sector. The curriculum focuses on skill development that aligns with the NCCER certification standards. Additionally, students have the chance to engage in Career and Technical Education (CTE) student organizations, such as SkillsUSA.

Industry Certification
NCCER Learning Series

College, Career, and Certifications
NCCER Learning Series

Grade Level and Class Size Recommendations
It is recommended that students enter this program as sophomores. Exceptions to this are a district-level decision based on class size, enrollment numbers, student maturity, and CTE delivery method. This is a hands-on, lab- or shop-based course. Therefore, a maximum of 15 students is recommended per class, with only one class present with the teacher at a time. This is a classroom-based course.

Student Prerequisites
For students to experience success in the program, the following student prerequisites are suggested:

1. C or higher in English (the previous year)
2. C or higher in high school-level math (last course taken or the instructor can specify the level of math instruction needed)
3. Instructor approval and TABE reading score (eighth grade or higher)

or

1. TABE reading and math score (eighth grade or higher)
2. Instructor approval

or

1. Instructor approval

Assessment
The latest assessment blueprint for the curriculum can be found at https://www.rcu.msstate.edu/curriculum

Teacher Licensure
The latest teacher licensure information can be found at mdek12.org/oel/apply-for-an-educator-license.

Professional Learning
If you have specific questions about the content of any of training sessions provided, please contact the RCU at 662.325.2510 or helpdesk@rcu.msstate.edu.

Course Outlines

Option 1—Two 1-Carnegie Unit Courses

This curriculum consists of two 1-credit courses, which should be completed in the following sequence:

1. **Theory and Application of Electrical I—Course Code: 993121**
2. **Theory and Application of Electrical II—Course Code: 993122**

Course Description: Theory and Application of Electrical I
This course is designed to incorporate an in-depth study of electrical theory and an introduction to wiring. This one Carnegie unit course should only be taken after students successfully pass Safety and Orientation to Construction and Introduction to Construction.

Course Description: Theory and Application of Electrical II
This course is designed around an in-depth study of device boxes, hand bending, conductors and cables, and electrical drawings. This one Carnegie unit course should only be taken after students successfully pass Theory and Application of Electrical I.

Theory and Application of Electrical I—Course Code: 993121

Unit	Unit Title	Hours
1	Orientation	6
2	Safety	29
3	Introduction to Circuits	14
4	Electrical Theory	19
5	Test Equipment	9
6	Introduction to NEC	24
7	Residential Wiring	39
Total		**140**

Theory and Application of Electrical II—Course Code: 993122

Unit	Unit Title	Hours
8	Device Boxes	26
9	Wireways, Raceways, and Fittings	26
10	Hand Bending	31
11	Conductors and Cables	31
12	Basic Electrical Construction Documents	26
Total		**140**

Option 2—One 2-Carnegie Unit Course

This curriculum consists of one 2-credit course to be completed.

1. **Electrical—Course Code 993120**

Course Description: Electrical
This course consists of an in-depth study of electrical theory, an introduction to wiring, devices, and boxes, hand bending, conductors and cables, and electrical drawings. This two Carnegie unit course should only be taken after students successfully pass Construction Core. Upon completing the two courses, students will know how to successfully earn their NCCER Level I Certification.

Electrical—Course Code: 993120

Unit	Unit Name	Hours
1	Orientation and the Electrical Industry	6
2	Safety	29
3	Introduction to Circuits	14
4	Electrical Theory	19
5	Test Equipment	9
6	Introduction to NEC	24
7	Residential Wiring	39
8	Device Boxes	26
9	Wireways, Raceways, and Fittings	26
10	Hand Bending	31
11	Conductors and Cables	31
12	Basic Electrical Construction Documents	26
Total		**280**

Career Pathway Outlook

Overview

Individuals in an electrical technology–related career will encounter the installation, maintenance, and oversight of electrical and power systems for residential, commercial, and manufacturing establishments. Skills for electrical occupations may be obtained in on-the-job training but may require as much as an advanced degree. Electrical technology focuses on the design and development of equipment that is powered by electricity or electric current. It explores electrical power distribution, process control, and instrumentation design. The program includes installing electrical control systems, planning project timelines, calibrating equipment, and programming electronic controls. Students enrolled in this program will discover how to read blueprints, which include technical diagrams of electrical systems that show the location of circuits, outlets, and other equipment. They will use different types of hand tools and power tools, such as conduit benders, to run and protect wiring. The students will troubleshoot electrical issues using ammeters, voltmeters, thermal scanners, and cable testers to find problems and ensure the components work properly. A shortlist of job sites where individuals may perform their work within their electrical technology–related careers may be in homes both indoors and outdoors, as well as within businesses, factories, and construction sites. Electrical technology careers include electricians, electrical engineers, power installers, electronics repair technicians, industrial equipment technicians, etc.

Most electrical technology–related careers require at least an associate degree, although careers with the highest earning potential—engineers and postsecondary teachers, for example—usually require advanced degrees. Electrical engineers, for example, may be required to design new ways to use electrical power to develop or improve products to detailed specifications. They may also collaborate with project managers on production efforts to ensure that projects are completed satisfactorily, on time, and within budget.

Needs of the Future Workforce

According to the U.S. Bureau of Labor Statistics, national employment of electricians is projected to grow by 7% from 2021 to 2031. About 79,900 electrician openings are projected each year in the same timeframe. Nationally, the median annual wage for electricians was $60,040 in May 2021. In Mississippi, the average employment growth total from 2020 to 2030 is projected to increase by 9.5% for all general occupations combined. The highest concentration of electrician jobs in Mississippi are located in the Gulfport, Biloxi, and Pascagoula regions. There are 1,770 total electricians in those combined areas. There are 12 electrician jobs per 1,000 residents and their annual mean wage is $57,010. The data given in Table 1.1 below, including the average hourly earnings, was compiled from the Mississippi Department of Employment Security (MDES) in 2022.

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2020	Projected Jobs, 2030	Change (Number)	Change (Percent)	Average Hourly Earnings, Year
Electrician	5,780	6,280	500	8.7%	$26.08, 2022
Electrical Engineers	1,260	1,300	40	3.2%	$43.65, 2022

Electrical and Electronic Engineering Technologists and Technicians	850	870	20	2.4%	$28.29, 2022
Electrical and Electronics Repairers, Commercial and Industrial Equipment	530	530	0	0%	$29.90, 2022
Electrical and Electronics Drafters	70	70	0	0%	$27.47, 2022
Telecommunications Equipment Installers and Repairers	3,050	3,190	140	4.6%	$29.45, 2022
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	530	530	0	0%	$35.08, 2022
Electrical Power-Line Installers and Repairers	2,020	2,130	110	5.4%	$31.09, 2022

Source: Mississippi Department of Employment Security; mdes.ms.gov (2022).

Perkins V Requirements and Academic Infusion

The electrical curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in electrical fields. It also offers students a program of study, including both secondary and postsecondary courses, that will further prepare them for electrical careers. Additionally, this curriculum is integrated with academic college- and career-readiness standards. Lastly, it focuses on ongoing and meaningful professional development for teachers as well as relationships with industry.

Transition to Postsecondary Education

The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website, mccb.edu.

Best Practices

Innovative Instructional Technologies

Classrooms should be equipped with tools that will teach today's digital learners through applicable and modern practices. The electrical educator's goal should be to include teaching strategies that incorporate current technology. To make use of the latest online communication tools—wikis, blogs, podcasts, and social media platforms, for example—the classroom teacher is encouraged to use a learning management system that introduces students to education in an online environment and places more of the responsibility of learning on the student.

Differentiated Instruction

Students learn in a variety of ways, and numerous factors—students' background, emotional health, and circumstances, for example—create unique learners. By providing various teaching

and assessment strategies, students with various learning preferences can have more opportunity to succeed.

CTE Student Organizations
Teachers should investigate opportunities to sponsor a student organization. There are several here in Mississippi that will foster the types of learning expected from the electrical curriculum. SkillsUSA is an example of a student organizations with many outlets for electrical students. Student organizations provide participants and members with growth opportunities and competitive events. They also open the doors to the world of electrical careers and scholarship opportunities.

Cooperative Learning
Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the electrical curriculum for group work. To function in today's workforce, students need to be able to work collaboratively with others and solve problems without excessive conflict. The electrical curriculum provides opportunities for students to work together and help each other complete complex tasks. There are many field experiences within the electrical curriculum that will allow and encourage collaboration with professionals currently in the electrical field.

Work-Based Learning
Work-based learning is an extension of understanding competencies taught in the electrical classroom. This curriculum is designed in a way that necessitates active involvement by the students in the community around them and the global environment. These real-world connections and applications link to all types of students to knowledge, skills, and professional dispositions. Work-based learning should encompass ongoing and increasingly more complex involvement with local companies and electrical professionals. Thus, supervised collaboration and immersion into the electrical industry around the students are keys to students' success, knowledge, and skills development.

Professional Organizations

Association for Career and Technical Education (ACTE)
acteonline.org

International Association of Electrical Inspectors (IAEI)
iaei.org

National Center for Construction Education and Research (NCCER).
nccer.org/

National Electrical Contractors Association (NECA)
necanet.org

SkillsUSA – Mississippi
mdek12.org/CTE/SO/SkillsUSA

SkillsUSA – National
skillsusa.org

Using This Document

Competencies and Suggested Objectives
A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Teacher Resources
All teachers should request to be added to the Canvas Teacher Resource Guide for their course. For questions or to added to the guide send a help desk ticket to the RCU by emailing helpdesk@rcu.msstate.edu.

Perkins V Quality Indicators and Enrichment Material
Some of the units may include an enrichment section at the end. This material will greatly enhance the learning experiences for students. If the electrical program is using a national certification, work-based learning, or other measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be assessed on that quality indicator. It is the responsibility of the teacher to ensure all competencies for the selected quality indicator are covered throughout the year.

Unit 1:Orientation and the Electrical Industry

Competencies and Suggested Objectives
1. Describe local program and career center expectations, policies, and procedures. DOK 1 a. Describe local program and career center policies and procedures, including dress code, attendance, academic requirements, discipline, shop/lab rules and regulations, and transportation regulations. b. Give a brief overview of the course. Explain to students what electrical technology is, why it is important, and how it will be delivered. c. Compare and contrast local program and school policies to the expectations of employers. d. Preview course objectives, program policy, and industry standards.
2. Describe the apprenticeship/training process for electricians. DOK 1 a. Identify an employment pathway and the tools used by job seekers. b. Explain the general requirements for apprenticeship programs.
3. Describe various career paths/opportunities one might follow in the electrical trade. DOK 1 a. Describe employment opportunities and responsibilities. b. Identify common electrical systems.
4. Explore leadership skills and personal development opportunities provided to students by student organizations, including SkillsUSA. DOK 2 a. Demonstrate effective team building and leadership skills.

Unit 2: Safety

Competencies and Suggested Objectives
1. Develop a task plan and a hazard assessment for a given task and select the appropriate personal protective equipment (PPE) and work methods to safely perform the task. DOK 2 a. Explain the importance of following all safety rules and company safety policies.
2. Review general safety rules for working in a shop/lab and in industry. DOK 1 a. Describe how to avoid on-site accidents. b. Explain the relationship between housekeeping and safety. c. Explain the importance of following all OSHA safety regulations, NFPA-70E, and company safety policies. d. Recognize, explain, and maintain PPE. e. Explain the importance of reporting all on-the-job injuries, accidents, and near misses. f. Explain the need for evacuation policies and the importance of following them. g. Explain the employer's substance abuse policy and how it relates to safety. h. Explain the safety procedures when working near pressurized or high-temperature systems.

Note: Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be documented in each student's file.
Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 3: Introduction to Electrical Circuits

Competencies and Suggested Objectives
1. Define the units of measurement used to measure the properties of electricity. DOK 1 a. Describe laws of electrical charges, including like and unlike charges. b. Describe methods of generating electricity, including solar, chemical, mechanical, and thermal. c. Describe the terms and scientific principles associated with direct and alternating current electricity. d. Define terms associated with the nature of matter, including physical characteristics of matter (elements, compounds, atoms, electrons, protons, and neutrons).
2. Explain the difference between conductors and insulators. DOK 1 a. Identify electrical materials including conductors and insulators.
3. Demonstrate reading schematic diagrams. DOK2 a. Interpret various electrical symbols. b. Distinguish between series and parallel circuits.

Unit 4: Electrical Theory

Competencies and Suggested Objectives
1. Explain the basic characteristics and calculation of series, parallel, and combination circuits. DOK 2 a. Draw and construct a series, parallel, and combination circuit with a minimum of three resistances. b. Calculate and measure circuit parameters for a series, parallel, and combination circuit. c. Using Kirchhoff's voltage law, calculate the voltage drop in series, parallel, and series-parallel circuits. d. Using Kirchhoff's current law, calculate the total current in parallel and series-parallel circuits.

Unit 5: Test Equipment

Competencies and Suggested Objectives
1. Identify and explain the operation of various pieces of test equipment. DOK 2 a. Demonstrate how to use various types of meters, including a voltmeter, ohmmeter, ammeter, clamp-on ammeter, megger, multi-meter, etc., and discuss each purpose for given projects. b. Demonstrate the types of electrical/electronic testing equipment using the proper safety.
2. Discuss meter category ratings and safety requirements. DOK1 a. Select a meter using the correct category rating.

Unit 6: Introduction to the NEC

Competencies and Suggested Objectives
1. Explain the purpose, navigational layout, and history of the National Electric Code (NEC). DOK 1 a. Discuss why the NEC was formed and its role in daily work. b. Discuss all sections and tabs of the handbook and their importance. c. List specific terms of importance to help navigate through the handbook. d. Explain how changes are made to the NEC.
2. Describe the purpose of the National Electrical Manufacturers Association (NEMA) and the National Fire Protection Association (NFPA). DOK 1 a. Discuss the purpose of the NEMA and the NFPA standards. b. Explain the role of nationally recognized testing laboratories.
3. Explain the role of the NEC in residential wiring and describe how to determine electric service requirements for dwellings. DOK 2 a. Describe the materials necessary for various service entrances and determine local requirements.

Unit 7: Residential Wiring

Competencies and Suggested Objectives
1. Calculate and select service entrance equipment. DOK 2 a. Demonstrate all parts of service entrance equipment to comply with the requirements according to the National Electric Code (NEC).
2. Explain the types and purposes of grounding equipment. DOK 2 a. Discuss ground fault circuit interrupters (GFCI) and the role they play in making electrical connections. b. Identify the different types of grounding electrodes. c. Identify installations that require GFCI protection according to the NEC.
3. Install service entrance equipment. DOK3 a. Determine local requirements. b. Determine service drop location. c. Identify panel board location.
4. Select the proper wiring methods for various types of residences and commercial facilities. DOK 2 a. Select and install cable systems raceways.
5. Compute branch circuit loads and explain their installation requirements. DOK 2 a. Select the minimum number of branch circuits of a typical single-dwelling house based on service calculators.
6. Size outlet boxes and select the proper type for different wiring methods. DOK 3 a. Discuss the NEC requirements for outlet boxes. b. Identify different wiring methods used in residential and commercial wiring.
7. Describe the installation rules for electrical systems around swimming pools, spas, and hot tubs. DOK 2 a. Determine the NEC requirements for wiring around water.
8. Explain how wiring devices are selected and installed. DOK 2 a. Identify the materials needed to install the electrical system in a home. b. Describe the importance of having and following electrical blueprints when installing an electrical system.
9. Describe the installation and control of lighting fixtures according to the NEC. DOK 2 a. Demonstrate installation requirements for installing lighting fixtures.

Unit 8:Device Boxes

Competencies and Suggested Objectives
1. Describe the different types of nonmetallic and metallic boxes. DOK 1 a. Discuss the National Electric Code (NEC) standards for use of nonmetallic and metallic boxes based on indicated service requirements. b. Determine grounding requirements.
2. Calculate the NEC fill requirements for boxes under 100 cubic inches. DOK 2 a. Install pull and junction boxes.

Unit 9: Wireways, Raceways, and Fittings

Competencies and Suggested Objectives
1. Identify, select, and install various types and sizes of raceways and fittings for a given application in both residential and commercial settings. DOK 2 a. Discuss various types of raceways and tubing and cable trays used for raceways. b. Identify various methods used to fabricate (join), install, and support raceway systems.
2. Identify the appropriate conduit body for a given application. DOK 2 a. Discuss metallic and nonmetallic conduit, tubing, and fittings of different types, grades, sizes, and weights (wall thicknesses) for designated services.
3. Select and install fasteners and anchors. DOK 2 a. Select and install tie wraps, screws, hammer-driven pins and studs, and various anchors.
4. Select and install cable trays. DOK 2 a. Determine cable tray types and fittings. b. Install cable trays according to the National Electric Code. c. Handle and store raceways

Unit 10: Hand Bending

Competencies and Suggested Objectives
1. Identify the methods for hand bending and installing conduit. DOK 2 a. Demonstrate various hand-bending techniques.
2. Determine conduit bends. DOK 2 a. Identify conduit bends and their uses.
3. Use geometry to make 90-degree bends, back-to-back bends, offsets, kicks, and saddle bends using a hand bender. DOK 2 a. Examine the many bends required to run conduit. b. Cut, ream, and thread conduit.

Unit 11: Conductors and Cables

Competencies and Suggested Objectives
1. Examine cable materials, markings, and how the cable markings are used. DOK 2 a. Use cable markings to describe the following: • Insulation and jacket material • Conductor size and type • Number of conductors • Temperature rating • Voltage rating • Ampacity • Permitted uses b. Discuss materials commonly used for conducting electricity. c. Differentiate between various wiring materials and their ampacity.
2. Identify the National Electric Code (NEC) requirements for color-coding of conductors. DOK 2 a. Explain the purpose of the different colors of wire.
3. Install conductors in a raceway system. DOK 2 a. Discuss appropriate conductors and their uses according to the NEC. b. Select all proper tools and materials to install appropriate conductors in a raceway system.

Unit 12: Basic Electrical Construction Documents

Competencies and Suggested Objectives
1. Explain the basic layout of a set of construction drawings. DOK 2 a. Discuss common terms and symbols associated with a drawing. b. Describe the information included in the title block of a construction drawing. c. Identify the types of lines used on construction drawings.
2. Using multiple scales, state the actual dimensions of a given drawing component. DOK 2 a. Explain various scales and demonstrate how to use them when interpreting drawings.
3. Interpret symbols, including electrical, mechanical, plumbing, and structural. DOK 2 a. Analyze and explain equipment schedules, block diagrams, and schematic diagrams found on electrical blueprints.
4. Identify and describe the type of information included in electrical specifications. DOK 1 a. Explain Request for Information (RFI). b. Compare the different formats of written specifications.

Student Competency Profile

Student Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Orientation and the Electrical Industry		
	1.	Describe local program and career center expectations, policies, and procedures.
	2.	Describe the apprenticeship/training process for electricians.
	3.	Describe various career paths/opportunities one might follow in the electrical trade.
	4.	Explore leadership skills and personal development opportunities provided to students by student organizations, including SkillsUSA.
Unit 2: Safety		
	1.	Develop a task plan and a hazard assessment for a given task and select the appropriate personal protective equipment (PPE) and work methods to safely perform the task.
	2.	Review general safety rules for working in a shop/lab and in industry.
Unit 3: Introduction to Electrical Circuits		
	1.	Define the units of measurement used to measure the properties of electricity.
	2.	Explain the difference between conductors and insulators.
	3.	Demonstrate reading schematic diagrams.
Unit 4: Electrical Theory		
	1.	Explain the basic characteristics and calculation of series, parallel, and combination circuits.
Unit 5: Test Equipment		
	1.	Identify and explain the operation of various pieces of test equipment.
	2.	Discuss meter category ratings and safety requirements.
Unit 6: Introduction to the NEC		
	1.	Explain the purpose, navigational layout, and history of the National Electric Code (NEC).
	2.	Describe the purpose of the National Electrical Manufacturers Association (NEMA) and the National Fire Protection Association (NFPA).
	3.	Explain the role of the NEC in residential wiring and describe how to determine electric service requirements for dwellings.

Unit 7: Residential Wiring		
	1.	Calculate and select service entrance equipment.
	2.	Explain the types and purposes of grounding equipment.
	3.	Install service entrance equipment.
	4.	Select the proper wiring methods for various types of residences and commercial facilities.
	5.	Compute branch circuit loads and explain their installation requirements.
	6.	Size outlet boxes and select the proper type for different wiring methods.
	7.	Describe the installation rules for electrical systems around swimming pools, spas, and hot tubs.
	8.	Explain how wiring devices are selected and installed.
	9.	Describe the installation and control of lighting fixtures according to the NEC.
Unit 8: Device Boxes		
	1.	Describe the different types of nonmetallic and metallic boxes.
	2.	Calculate the NEC fill requirements for boxes under 100 cubic inches.
Unit 9: Wireways, Raceways, and Fittings		
	1.	Identify, select, and install various types and sizes of raceways and fittings for a given application in both residential and commercial settings.
	2.	Identify the appropriate conduit body for a given application.
	3.	Select and install fasteners and anchors.
	4.	Select and install cable trays.
Unit 10: Hand Bending		
	1.	Identify the methods for hand bending and installing conduit.
	2.	Determine conduit bends.
	3.	Use geometry to make 90-degree bends, back-to-back bends, offsets, kicks, and saddle bends using a hand bender.
Unit 11: Conductors and Cables		
	1.	Examine cable materials, cable markings, and how the cable markings are used.
	2.	Identify the National Electric Code (NEC) requirement for color-coding of conductors.
	3.	Install conductors in a raceway system.
Unit 12: Basic Electrical Construction Drawings		
	1.	Explain the basic layout of a set of construction drawings.
	2.	Using multiple scales, state the actual dimensions of a given drawing component.
	3.	Interpret symbols, including electrical, mechanical, plumbing, and structural.
	4.	Identify and describe the type of information included in electrical specifications.

Appendix A: Industry Standards

	Units	1	2	3	4	5	6	7	8	9	10	11	12
ELO		X											
ELS			X										
ELC				X									
ELT					X								
ENC							X						
EDB									X				
EHB											X		
ERF										X			
ECC												X	
ECD													X
ERS								X					
ETE						X							

National Center for Construction Education and Research (NCCER)-Learning Series Standards for the Electrical Program

ELO—Module One (26101-20) – Occupational Overview: The Electrical Industry
ELS—Module Two (26102-20) – Safety for Electricians
ELC—Module Three (26103-20) – Introduction to Electrical Circuits
ELT—Module Four (26104-20) – Electrical Theory
ENC—Module Five (26105-20) – Introduction to the National Electric Code
EDB—Module Six (26106-20) – Device Boxes
EHB—Module Seven (26107-20) – Hand Bending
ERF—Module Eight (26108-20) – Wireways, Raceways, and Fittings
ECC—Module Nine (26109-20) – Conductors and Cables
ECD—Module Ten (26110-20) – Basic Electrical Construction Documents
ERS—Module Eleven (26111-20) – Residential Wiring
ETE—Module Twelve (26112-20) – Electrical Test Equipment