

Title 7: Education K-12

Part 85: Trades Industrial, Secondary

MISSISSIPPI
CURRICULUM FRAMEWORK
FOR
ELECTRICIAN
(Program CIP: 46.0302 - Electrician)

SECONDARY

2004

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2004

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FOREWORD

The courses in this document reflect the following statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended:

§ 37-3-49. Adoption by school district of instructional program and management system; paperwork reduction.

(1) The State Department of Education shall provide an instructional program and establish guidelines and procedures for managing such program in the public schools as part of the State Program of Educational Accountability and Assessment of Performance as prescribed in Section 37-3-46. Public school districts may (a) elect to adopt the instructional program and management system provided by the State Department of Education, or (b) elect to adopt an instructional program and management system which meets or exceeds criteria established by the State Department of Education for such. This provision shall begin with the courses taught in Grades K-8 which contain skills tested through the Mississippi Basic Skills Assessment Program and shall proceed through all secondary school courses mandated for graduation and all secondary school courses in the Mississippi end-of-course testing program. Other state core objectives must be included in the district's instructional program as they are provided by the State Department of Education along with instructional practices, resources, evaluation items and management procedures. Districts are encouraged to adapt this program and accompanying procedures to all other instructional areas. The department shall provide that such program and guidelines, or a program and guidelines developed by a local school district which incorporates the core objectives from the curriculum structure are enforced through the performance-based accreditation system. It is the intent of the Legislature that every effort be made to protect the instructional time in the classroom and reduce the amount of paperwork which must be completed by teachers. The State Department of Education shall take steps to insure that school districts properly use staff development time to work on the districts' instructional management plans.

(2) The State Department of Education shall provide such instructional program and management guidelines which shall require for every public school district that:

(a) All courses taught in Grades K-8 which contain skills which are tested through the Mississippi Basic Skills Assessment Program, all secondary school courses mandated for graduation, and all courses in the end-of-course testing program shall include the State Department of Education's written list of learning objectives.

(b) The local school board must adopt the objectives that will form the core curriculum which will be systematically delivered throughout the district.

(c) The set of objectives provided by the State Department of Education must be accompanied by suggested instructional practices and resources that would help teachers organize instruction so as to promote student learning of the objectives. Objectives added by the school district must also be accompanied by suggested instructional practices and resources that would help teachers organize instruction. The instructional practices and resources that are identified are to be used as suggestions and not as requirements that teachers must follow. The goal of the program is to have students to achieve the desired objective and not to limit teachers in the way they teach.

(d) Standards for student performance must be established for each core objective in the local program and those standards establish the district's definition of mastery for each objective.

(e) There shall be an annual review of student performance in the instructional program against locally established standards. When weaknesses exist in the local instructional program, the district shall take action to improve student performance.

(3) The State Board of Education and the board of trustees of each school district shall adopt policies to limit and reduce the number and length of written reports that classroom teachers are required to prepare.

(4) This section shall not be construed to limit teachers from using their own professional skills to help students master instructional objectives, nor shall it be construed as a call for more detailed or complex lesson plans or any increase in testing at the local school district level.

(5) In the event any school district meets Level 4 or 5 accreditation requirements, the State Board of Education may, in its discretion, exempt such school district from the provisions of this section.

SOURCES: Laws, 1988, ch.487, §14; Laws, 1991, ch.423, §1; Laws, 1992, ch.519, §4 eff. from and after July 1, 1992.

Each secondary vocational-technical course consists of a series of instructional units which focus on a common theme. All units have been written using a common format which includes the following components:

- Unit Number and Title
- Suggested Time on Task - An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75-80 percent of the time in the course.
- 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.
- Suggested Teaching Strategies - This section of each unit indicates strategies that can be used to enable students to master each suggested objective. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.
- Suggested Assessment Strategies - This section indicates strategies that can be used to measure student mastery. Examples of suggested strategies could include classroom discussions, laboratory exercises, and student assignments. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.
- Integrated Academic Topics, Workplace Skills, and Occupational Standards - This section identifies related academic topics in mathematics, science, and communications which are integrated into the content of the unit. It also identifies the general workplace skills as identified in the Secretary's Commission on Achieving Necessary Skills (SCANS) report as being critical for all workers in the 21st Century. Finally where applicable, occupational skills standards associated with the competencies and suggested objectives for the unit are also identified.

- Suggested References - This section indicates some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested and the list may be modified or enhanced based on needs and abilities of students and on available resources.

The following guidelines were used in developing the curriculum framework in this document and should be considered in developing local instructional management plans and daily lesson plans:

- The content of the courses in this document reflects approximately 75-80 percent of the time allocated to each course. The remaining 20-25 percent of each course should be developed at the local district level and may reflect:
 - Additional units of instruction within the course related to topics not found in the state framework.
 - Activities which develop a higher level of mastery on the existing competencies and suggested objectives.
 - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed/ revised.
 - Activities which implement components of the Mississippi Tech Prep initiative, including integration of academic and vocational-technical skills and coursework, school-to-work transition activities, and articulation of secondary and postsecondary vocational-technical programs.
 - Individualized learning activities to better prepare individuals in the courses for their chosen occupational area.
- Sequencing of the units of instruction within a course is left to the discretion of the local district. Naturally, foundation units related to topics such as safety, tool and equipment usage, and other basic skills should be taught first. Other units related to specific skill areas in the course, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors.

May 21, 2004

ACKNOWLEDGMENTS

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May 21, 2004

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PROGRAM DESCRIPTION

ELECTRICIAN

(Program CIP: 46.0302 – Electrician)

Electrician is an instructional program which prepares secondary students to enter residential electricity occupations. Students in Electrician I complete a common core program of study including orientation (including employment skills), leadership and personal development, basic safety, basic math, hand and power tools, direct current circuits, alternating current circuits, introduction to residential wiring, basic rigging, and introduction to blueprints. Students in Electrician II continue study in basic safety, AC circuits for residential wiring, load centers and overcurrent protection, rough-in, residential service, trim-out and troubleshooting, motors and controllers, introduction to programmable logic controllers, and commercial and industrial wiring. Upon completion of study, graduates may elect to continue their education or become employed in the electrical trades industry as a helper or apprentice.

This curriculum in Electrician was developed using the competencies and objectives as developed by the National Center for Construction Education and Research (NCCER), 2002, and the National Electrical Contractors Association (NECA). Also, the National Electrical Code book (2002) was used to ensure compliance with applicable codes.

COURSE OUTLINE

ELECTRICIAN I

<u>Unit #</u>	<u>Title</u>	<u>No. of Hours</u>
Unit 1	Orientation/Leadership and Personal Development	7.5
Unit 2	Basic Safety	15.0
Unit 3	Basic Math	15.0
Unit 4	Hand and Power Tools	15.0
Unit 5	Direct Current (DC) Circuits	20.0
Unit 6	Alternating Current (AC) Circuits	15.0
Unit 7	Introduction to Residential Wiring	85.0
Unit 8	Basic Rigging	20.0
Unit 9	Introduction to Blueprints	10.0

ELECTRICIAN II

<u>Unit #</u>	<u>Title</u>	<u>No. of Hours</u>
Unit 1	Basic Safety (Review)	8.0
Unit 2	AC Circuits for Residential Wiring	37.5
Unit 3	Load Centers and Overcurrent Protection	7.5
Unit 4	Rough-in	25.0
Unit 5	Residential Service	7.5
Unit 6	Trim-out and Troubleshooting	27.5
Unit 7	Motors and Controllers	27.5
Unit 8	Introduction to Programmable Logic Controllers (PLC)	20.0
Unit 9	Commercial and Industrial Wiring	42.5

SECTION I:
CURRICULUM GUIDE
FOR
ELECTRICIAN

ELECTRICIAN I

**UNIT 1: ORIENTATION/LEADERSHIP
AND PERSONAL DEVELOPMENT**

(7.5 hours)

Competencies and Suggested Objectives:

1. Describe local program and vocational center policies and procedures.
 - a. Describe local program and vocational center policies and procedures including dress code, attendance, academic requirements, discipline, shop/lab rules and regulations, and transportation regulations.
2. Describe employment opportunities and responsibilities for electricians and related employees.
 - a. Describe employment opportunities available for electricians, electronics technicians, and electrical related employees including potential earnings, employee benefits, job availability, possible places of employment, working conditions, and educational requirements.
 - b. Describe basic employee responsibilities including punctuality, physical requirements, customer relations, following directions, job safety, and entry level skills.
3. State procedures of leadership used to reach an agreement in an orderly manner and personal development opportunities provided students in electricity trades by SkillsUSA.
 - a. State procedures of leadership used in organizational meetings to reach an agreement in an orderly manner including procedures for gaining recognition in a meeting and conducting a SkillsUSA meeting.
 - b. Describe the purposes of SkillsUSA including leadership development, personal development, and skills competition.

Suggested Teaching Strategies:

1. Describe local program and vocational center policies and procedures.
 - a. Review and discuss applicable rules and regulations.
2. Describe employment opportunities and responsibilities for electricians and related employees.
 - a. Have students survey job opportunities through employer visits, resource person(s), telephone calls, help wanted ads, Career Center visit, Internet research, or a field trip with report of findings to the class.
 - b. Have resource person speak to students regarding requirements for punctuality, physical requirements, customer relations, following directions, job safety, and entry level skills.

3. State procedures of leadership used to reach an agreement in an orderly manner and personal development opportunities provided students in electrical trades by the SkillsUSA.
 - a. Allow students to attend a formal meeting to observe "Robert's Rules of Order" in operation. Give a hand-out on procedures for "Robert's Rules of Order." Encourage a classroom discussion concerning "Robert's Rules of Order."
 - b. Discuss leadership opportunities for students.

Suggested Assessment Strategies:

1. Describe local program and vocational center policies and procedures.
 - a. Test on applicable rules and regulations.
2. Describe employment opportunities and responsibilities for electricians and related employees.
 - a. Oral and/or written report on employment opportunities.
 - b. Oral and/or written report on employee responsibilities.
3. State procedures of leadership used to reach an agreement in an orderly manner and personal development opportunities provided students in electrical trades by the SkillsUSA.
 - a. Oral and/or written review.
 - b. Oral and/or written review.

Standards

Academic Standards

- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP1 Allocates resources (time, money, materials and facilities, and human resources).
- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.

- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools
- T5 Technology research tools

Standards for Electrician Taken from National Center for Construction Education and Research

ELT1.1 Electrical Safety

Suggested References

Choices [Computer software]. (2004). Oroville, WA: Bridges.com Co.

High School Career Centers.

Local School District Handbook.

SkillsUSA-VICA. (2001). *Student handbook*. Washington, DC: Vocational Industrial Clubs of America (VICA).

Additional Resources:

Community resource professionals.

What do employers expect from me? (Poster). Available from Tech Prep Office, Mississippi Department of Education.

**ELECTRICIAN I
UNIT 2: BASIC SAFETY****(15.0 hours)****Competencies and Suggested Objectives:**

1. Describe general safety rules for working in a shop/lab and industry.
 - a. Describe how to avoid on-site accidents.
 - b. Explain the relationship between housekeeping and safety.
 - c. Explain the importance of following all safety rules and company safety policies.
 - d. Explain the importance of reporting all on-the-job injuries, accidents, and near misses.
 - e. Explain the need for evacuation policies and the importance of following them.
 - f. Explain the employer=s substance abuse policy and how it relates to their safety.
 - g. Explain the safety procedures when working near pressurized or high temperature systems.
2. Identify and apply safety around welding operations.
 - a. Use proper safety practices when welding or working around welding operations.
 - b. Use proper safety practices when welding in or near trenches and excavations.
 - c. Explain the term proximity work.
3. Identify and explain use of various barriers and confinements.
 - a. Explain the safety requirements for working in confined areas.
 - b. Explain and practice lockout/tagout procedures.
 - c. Explain the different barriers and barricade, and how they are used.
 - d. Recognize and explain personal protective equipment.
 - e. Inspect and care for personal protective equipment.
4. Recognize safe lifting and the use of ladders and scaffolds.
 - a. Identify and explain the procedures for lifting heavy objects.
 - b. Inspect and safely work with various ladders and scaffolds.
5. Explain the Material Safety Data Sheets (MSDS).
 - a. Explain the function of the MSDS.
 - b. Interpret the requirements of the MSDS.
6. Explain fires.
 - a. Explain the process by which fires start.
 - b. Explain fire prevention of various flammable liquids.
 - c. Explain the classes of fire and the types of extinguishers.
7. Explain safety in and around electrical situations.
 - a. Explain injuries when electrical contact occurs.
 - b. Explain safety around electrical hazards.
 - c. Explain action to take when an electrical shock occurs.

Suggested Teaching Strategies:

1. Describe general safety rules for working in a shop/lab and industry.
 - a. Give examples from personal experiences or recent accidents that have occurred.
 - b. Conduct a site tour of school pointing out good housekeeping practices and how these practices help make the worksite safe.
 - c. Discuss the school policies on rules of behavior, horseplay, etc., emphasizing the negative consequences of inappropriate behavior.
 - d. Discuss policies on reporting injuries, accidents, and near misses, emphasizing the need to report all injuries and why.
 - e. Describe the evacuation policies of facility and the importance of following these procedures. Emphasize the importance of evacuation on a job site.
 - f. Discuss the employer's substance abuse policy and how it relates to individual's safety.
 - g. Discuss safety guidelines for working near pressurized or high temperature systems. (Use transparencies.)
2. Identify and apply safety around welding operations.
 - a. Discuss safety practices to follow when welding or working around welding operations.
 - b. Demonstrate proper safety practices when welding in or near trenches and excavations.
 - c. Escort students around a job site or school facility. Have students identify at least one example of proximity work.
3. Identify and explain use of various barriers and confinements.
 - a. Discuss safety requirements for working in confined spaces, emphasizing the fact that confined spaces may contain hazardous gases or fluids.
 - b. Discuss the rules for working with a lockout/tagout system. Show sample tags. Students will respond to questions asked about where these systems may be found on a jobsite.
 - c. Discuss the different types and their uses of barriers or barricades typical to most jobsites.
 - d. Show various pieces of personal protective equipment and explain the purpose of each.
 - e. Discuss both safe and faulty personal protective equipment. Have students inspect each item and identify whether or not it is safe to use.
4. Recognize safe lifting and the use of ladders and scaffolds.
 - a. Discuss and demonstrate methods to identify and safely lift heavy objects. Under direct supervision of teacher, have students demonstrate how to correctly lift a heavy object.
 - b. Discuss and demonstrate how to inspect and safely work with ladders and scaffolds.
5. Explain the Material Safety Data Sheets (MSDS).
 - a. Hand out examples of MSDS and discuss the functions of them.
 - b. Using actual examples of MSDS, discuss the requirements of them.

6. Explain fires.
 - a. Discuss how a fire actually starts.
 - b. Discuss fire prevention of various flammable liquids.
 - c. Discuss the four classes of fires, stressing the importance of using the correct fire extinguisher on each fire. Have local fire department representative demonstrate the use of fire extinguishers.
7. Explain safety in and around electrical situations.
 - a. Discuss how injuries can occur from electrical contact.
 - b. Discuss and give examples of electrical hazards found on a job site and how to work safely around them.
 - c. Discuss what to do when an electrical shock occurs.

Suggested Assessment Strategies:

1. Describe general safety rules for working in a shop/lab and industry.
 - a. Oral and/or written test to determine how to avoid on-site accidents.
 - b. Oral and/or written test to determine the relationship between housekeeping and safety.
 - c. Oral and/or written test to determine the importance of following all safety rules and company safety policies.
 - d. Oral and/or written test to determine the importance of reporting all on-the-job injuries, accidents, and near misses.
 - e. Oral and/or written test and performance exercise.
 - f. Oral and/or written test to determine the employer's substance abuse policy and how it relates to the individual's safety.
 - g. Oral and/or written test to determine the safety procedures when working near pressurized or high temperature systems.
2. Identify and apply safety around welding operations.
 - a. Teacher observation and oral/written test to determine proper safety procedures when welding or working around welding operations.
 - b. Teacher observation and oral/written test to determine proper safety procedures when welding in or near trenches and excavations.
 - c. Use a rubric and oral/written test to determine student identification and definition of proximity work.
3. Identify and explain use of various barriers and confinements.
 - a. Teacher observation and oral and/or written test.
 - b. Teacher observation and oral and/or written test.
 - c. Oral and/or written test.
 - d. Teacher observation, written/oral test, using a rubric.
 - e. Teacher observation, written/oral test, using a rubric.
4. Recognize safe lifting and the use of ladders and scaffolds.
 - a. Teacher observation, written/oral test, using a rubric.
 - b. Teacher observation, written/oral test, using a rubric.
5. Explain the Material Safety Data Sheets (MSDS).
 - a. Oral and/or written test.

- b. Oral and/or written test.
- 6. Explain fires.
 - a. Oral and/or written test.
 - b. Oral and/or written test.
 - c. Oral and/or written test.
- 7. Explain safety in and around electrical situations.
 - a. Oral and/or written test.
 - b. Oral and/or written test.
 - c. Oral and/or written test.

Note: All safety tests must be 100 percent.

Standards

Academic Standards

- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T2 Social, ethical, and human issues
- T3 Technology productivity tools

Standards for Electrician Taken from National Center for Construction Education and Research

- ELT1.1 Electrical Safety
- ELT1.6 Electrical Test Equipment
- ELT1.7 Introduction to the National Electrical Code®

Suggested References

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Developing safety skills for shop or home. (2002). Winterville, GA: American Association for Vocational Instructional Materials & Tuscaloosa, AL: Resource Center for Technology.

High School Career Centers.

Kaltwasser, S., & Flowers, G. (2000). *Commercial and industrial wiring.* Stillwater, OK: Mid-America Vocational Curriculum Consortium.

Kaltwasser, S., Flowers, G., & Blasingame, D. (1999). *Basic wiring.* Stillwater, OK: Mid-America Vocational Curriculum Consortium.

Local School District Handbook.

National electrical code. (2002). Quincy, MA: National Fire Protection Association.

Additional Resources:

Community resource professionals.

Videos:

Safety videos. Available for short-term lease to Mississippi vocational and technical educators from the Research and Curriculum Unit for Workforce Development, P.O. Drawer DX, Mississippi State, MS 39762, Phone: 662-325-2510, Fax: 662-325-3296.

**ELECTRICIAN I
UNIT 3: BASIC MATH**

(15.0 hours)

Competencies and Suggested Objectives:

1. Apply basic math skills.
 - a. Add, subtract, multiply, and divide whole numbers with and without a calculator.
 - b. Use a standard and a metric rule to measure.
 - c. Add, subtract, multiply, and divide decimals with and without a calculator.
 - d. Convert decimals to percents and percents to decimals.
 - e. Convert fractions to decimals and percents to decimals.
 - f. Explain what the Metric System is and its importance in the electrical trade.
 - g. Recognize and use metric units of length, weight, volume, and temperature.

Suggested Teaching Strategies:

1. Apply basic math skills.
 - a. Review and discuss how to add, subtract, multiply, and divide whole numbers with and without a calculator.
 - b. Discuss and demonstrate how to use a standard and a metric rule to measure.
 - c. Demonstrate how to add, subtract, multiply, and divide decimals with and without a calculator. Solve problems from handouts on adding, subtracting, multiplying, and dividing decimals with and without a calculator.
 - d. Demonstrate how to solve problems changing decimals to percents and percents to decimals.
 - e. Demonstrate how to solve problems changing fractions to decimals and and percents to decimals.
 - f. Discuss the Metric System and its importance in the electrical trade..
 - g. Discuss how to recognize and demonstrate how to use metric units of length, weight, volume, and temperature.

Suggested Assessment Strategies:

1. Apply basic math skills.
 - a. Written test on the applicable rules of adding, subtracting, multiplying, and dividing whole numbers.
 - b. Observation, with use of a rubric or checklist, of students using the standard and metric rules to measure.
 - c. Written test on adding, subtracting, multiplying, and dividing decimals with and without a calculator.

- d. Written test on converting decimals to percents and percents to decimals.
- e. Written test on converting fractions to decimals and percents to decimals.
- f. Oral test on what the Metric System is and its importance to the electrical trade.
- g. Written test on recognizing and using metric units of length, weight, volume, and temperature.

Standards

Academic Standards

- A1 Recognize, classify, and use real numbers and their properties.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T6 Technology problem-solving and decision-making tools

Standards for Electrician Taken from National Center for Construction Education and Research

ELT1.1	Electrical Safety
ELT1.2	Hand Bending
ELT1.4	Electrical Theory One
ELT1.5	Electrical Theory Two
ELT1.6	Electrical Test Equipment
ELT1.9	Conductors
ELT1.10	Introduction to Electrical Blueprints
ELT1.11	Wiring: Commercial and Industrial
ELT1.12	Wiring Residential

Suggested References

Buban, P., Schmitt, M. L., & Carter, C. G., Jr. (1999). *Electricity and electronics technology*. New York: Glencoe/McGraw-Hill.

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

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Holzman, H. N. (2002). *Modern residential wiring*. Tinley Park, IL: Goodheart Willcox.

Kaltwasser, S., & Flowers, G. (2000). *Commercial and industrial wiring*. Stillwater, OK: Mid-America Vocational Curriculum Consortium.

Kaltwasser, S., Flowers, G., & Blasingame, D. (1999). *Basic wiring*. Stillwater, OK: Mid-America Vocational Curriculum Consortium.

ELECTRICIAN I
UNIT 4: HAND AND POWER TOOLS

(15.0 hours)

Competencies and Suggested Objectives:

1. Identify various hand and power tools used in electrical trades.
 - a. Identify common hand tools used in electrical trades.
 - b. Identify common types of power tools used in electrical wiring.
2. Explain the safe use of common hand and power tools used in electrical trades.
 - a. Explain the reasons for safety in the use of hand and power tools.
 - b. Explain the procedures for selecting the proper tool for the job.
 - c. Explain the safe use of each hand and power tool.
3. Explain the procedures for the maintenance of power tools.
 - a. Explain preventive maintenance.
 - b. Explain the procedures for the maintenance of power tools.
 - c. Demonstrate how to perform maintenance of power tools.

Suggested Teaching Strategies:

1. Identify various hand and power tools used in electrical trades.
 - a. Review and discuss common hand tools used in electrical trade.
 - b. Review and discuss common power tools used in electrical trade.
2. Explain the safe use of common hand and power tools used in electrical trades.
 - a. Discuss the various reasons that common hand and power tools need to be used safely.
 - b. Discuss procedures for selecting the proper tool for the job.
 - c. Discuss and demonstrate the safe use of common hand and power tools used in the electrical trade.
3. Explain the procedures for the maintenance of power tools.
 - a. Explain the procedures for the maintenance of power tools.
 - b. Discuss the procedures for the maintenance of power tools.
 - c. Show how to perform preventative maintenance on power tools.

Suggested Assessment Strategies:

1. Identify various hand and power tools used in electrical trades.
 - a. Oral/written test.
 - b. Oral/written test.
2. Explain the safe use of common hand and power tools used in electrical trades.
 - a. Oral/written test.
 - b. Oral/written test.
 - c. Oral/written test.
3. Explain the procedures for the maintenance of power tools.
 - a. Oral/written test.
 - b. Oral/written test.

- c. Application. Students will perform basic maintenance.

Standards

Academic Standards

- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP1 Allocates resources (time, money, materials and facilities, and human resources).
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T3 Technology productivity tools

Standards for Electrician Taken from National Center for Construction Education and Research

- ELT1.1 Electrical Safety
- ELT1.2 Hand Bending
- ELT1.11 Wiring: Commercial and Industrial

Suggested References

- Buban, P., Schmitt, M. L., & Carter, C. G., Jr. (1999). *Electricity and electronics technology*. New York: Glencoe/McGraw-Hill.

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Developing safety skills for shop or home. (2002). Winterville, GA: American Association for Vocational Instructional Materials & Tuscaloosa, AL: Resource Center for Technology.

Herman, S. L. (2004). *Delmar's standard textbook of electricity.* Clifton Park, NY: Delmar Thomson Learning.

Kaltwasser, S., Flowers, G., & Blasingame, D. (1999). *Basic wiring.* Stillwater, OK: Mid-America Vocational Curriculum Consortium.

National electrical code. (2002). Quincy, MA: National Fire Protection Association.

Videos:

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ELECTRICIAN I
UNIT 5: DIRECT CURRENT (DC) CIRCUITS**(20.0 hours)****Competencies and Suggested Objectives:**

1. Describe the terms and scientific principles associated with direct current electricity.
 - a. Define terms associated with the nature of matter including physical characteristics of matter (elements, compounds, atoms, electrons, protons, and neutrons).
 - b. Describe laws of electrical charges including like and unlike charges.
 - c. Identify electrical materials including conductors, insulators, and semiconductors.
 - d. Describe methods of generating electricity including solar, chemical, mechanical, and thermal.
 - e. Describe the principles and operation of batteries.
 - f. Describe basic theories of current flow including electron and conventional flow methods.
 - g. Describe DC circuit parameters including voltage, power, current, and resistance.
 - h. Identify resistor types and values using standard resistor color codes and alphanumeric codes.
 - i. Perform basic engineering notation calculations including conversion, adding, subtracting, multiplying, and dividing.
 - j. Identify DC circuit schematic symbols.
2. Create circuits and measure DC electricity using the multimeter.
 - a. Describe and demonstrate use of a multimeter including measuring voltage, current, and resistance.
 - b. Demonstrate use of Ohm's Law to calculate circuit parameters for a series circuit including voltage, current, resistance, and power.
 - c. Draw and construct a series circuit with a minimum of three resistances.
 - d. Calculate and measure circuit parameters for a series circuit.
 - e. Demonstrate use of Ohm's Law to calculate circuit parameters for a parallel circuit including voltage, current, resistance, and power.
 - f. Draw and construct a parallel circuit with a minimum of three resistances.
 - g. Calculate and measure circuit parameters for a parallel circuit.
 - h. Demonstrate use of Ohm's Law to calculate circuit parameters for a series-parallel circuit including voltage, current, resistance, and power.
 - i. Draw and construct a series-parallel circuit with a minimum of three resistances.
 - j. Calculate and measure circuit parameters for a series-parallel circuit.
3. Describe the principles of magnetism and electromagnetic properties.
 - a. Describe the principles of magnetism including magnetic fields, polarities, core materials, permeability, motor action, induced current, and associated laws.

- b. Describe the principles of electromagnetic properties including magnetic fields, polarities, core materials, permeability, motor action, induced current, and associated laws.
- c. Construct a simple electromagnet, including use of copper windings and a metal rod.

Suggested Teaching Strategies:

1. Describe the terms and scientific principles associated with direct current electricity.
 - a. Give students related handouts; review video on atom; discuss and demonstrate Bohr's Model of the Atom.
 - b. Discuss fundamental laws of electrical charges.
 - c. Give related handouts to students; pass out examples of conductors, insulators, and semiconductors; and introduce the atomic structure of each.
 - d. Have students research the different methods used to generate electricity.
 - e. Display different battery types and describe differences.
 - f. Discuss basic theories of current flow.
 - g. Introduce current, resistance, and power and explain their relationship to each other.
 - h. Pass out a selection of resistors and describe the resistor color code and alphanumeric code.
 - i. Review scientific notation and introduce engineering notation.
 - j. Discuss DC circuit symbols with handout of symbols.
2. Create circuits and measure DC electricity using the multimeter.
 - a. Pass out operator's manual for related multimeter, demonstrate procedures, and allow students to participate in related lab activities.
 - b. Have students calculate circuit parameters from example series circuits.
 - c. Have students draw and construct a three resistor series circuit.
 - d. Have students use calculator to obtain circuit parameters for a series circuit and verify calculations by measuring circuit parameters with multimeter.
 - e. Have students calculate parameters from example parallel circuits.
 - f. Have students draw and construct a three resistor parallel circuit.
 - g. Have students use calculator to obtain circuit parameters for a parallel circuit and verify calculations by measuring circuit parameters with multimeter.
 - h. Have students calculate circuit parameters from example series/parallel circuits.
 - i. Have students draw and construct a three resistor series/parallel circuit.
 - j. Have students use calculator to obtain circuit parameters for a series/parallel circuit and verify calculations by measuring circuit parameters with multimeter.
3. Describe the principles of magnetism and electromagnetic properties.
 - a. View video series on magnetism and discuss observations.

- b. View video series on electromagnetism and discuss observations.
- c. Pass out materials and allow students to construct an electromagnet.

Suggested Assessment Strategies:

1. Describe the terms and scientific principles associated with direct current electricity.
 - a. Written test.
 - b. Oral/written test.
 - c. Oral/written test.
 - d. Oral/written report.
 - e. Oral/written test.
 - f. Oral test.
 - g. Oral/written test.
 - h. Perform lab and identify resistor values.
 - i. Oral/written test.
 - j. Oral/written test.
2. Create circuits and measure DC electricity using the multimeter.
 - a. Observation of proper techniques.
 - b. Completion of student worksheet.
 - c. Observation and completed lab sheet.
 - d. Observation and completed lab sheet.
 - e. Completion of student worksheet with parallel circuit.
 - f. Observation and completed lab sheet with parallel circuit.
 - g. Observation and completed lab sheet with parallel circuit.
 - h. Observation and completed worksheet with series/parallel circuit.
 - i. Observation and completed lab sheet with series/parallel circuit.
 - j. Observation and completed lab sheet with series/parallel circuit.
3. Describe the principles of magnetism and electromagnetic properties.
 - a. Oral/written test.
 - b. Oral/written test.
 - c. Observation and lab sheet.

Standards

Academic Standards

- A5 Utilize various formulas in problem-solving situations.
- A6 Communicate using the language of algebra.
- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.

- E6 Explore cultural contributions to the history of the English language and its literature.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.). include civic responsibilities.

Workplace Skills

- WP1 Allocates resources (time, money, materials and facilities, and human resources).
- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools
- T6 Technology problem-solving and decision-making tools

Standards for Electrician Taken from National Center for Construction Education and Research

- ELT1.1 Electrical Safety
- ELT1.4 Electrical Theory One
- ELT1.5 Electrical Theory Two
- ELT1.6 Electrical Test Equipment
- ELT1.11 Wiring: Commercial and Industrial

Suggested References

Buban, P., Schmitt, M. L., & Carter, C. G., Jr. (1999). *Electricity and electronics technology*. New York: Glencoe/McGraw-Hill.

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Herman, S. L. (2004). *Delmar's standard textbook of electricity*. Clifton Park, NY: Delmar Thomson Learning.

Holzman, H. N. (2002). *Modern residential wiring*. Tinley Park, IL: Goodheart Willcox.

Kaltwasser, S., Flowers, G., & Blasingame, D. (1999). *Basic wiring*. Stillwater, OK: Mid-America Vocational Curriculum Consortium.

National electrical code. (2002). Quincy, MA: National Fire Protection Association.

Videos:

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ELECTRICIAN I
UNIT 6: ALTERNATING CURRENT (AC) CIRCUITS

(15.0 hours)

Competencies and Suggested Objectives:

1. Describe the terms and scientific principles associated with alternating current electricity.
 - a. Describe principles of AC generation.
 - b. Define terms associated with AC voltage.
 - c. Describe sources of AC voltage.
 - d. Describe distribution route and components used from power plant to home or business.
 - e. Describe the properties and characteristics of inductors.
 - f. Describe the properties and characteristics of transformers.
 - g. Describe properties and characteristics of capacitors.
 - h. Describe differences in phases in electrical power supply.
2. Describe and construct series and parallel circuits.
 - a. Draw and construct a series resistive circuit, calculating parameters and discussing phase relationship.
 - b. Draw and construct a parallel resistive circuit, calculating parameters and discussing phase relationship.
 - c. Draw and construct a series inductive circuit.
 - d. Draw and construct a parallel inductive circuit.

Suggested Teaching Strategies:

1. Describe the terms and scientific principles associated with alternating current electricity.
 - a. Pass out handouts and view videos on AC generation.
 - b. Pass out handouts and review terms and definitions.
 - c. Have students research AC voltage sources and prepare reports.
 - d. Use student handouts and videos with classroom discussion and tour of a power distribution system.
 - e. Use student handouts and videos with classroom discussion.
 - f. Use student handouts and videos with classroom discussion.
 - g. Use student handouts and videos with classroom discussion.
 - h. Use student handouts and conference with visual demonstration.
2. Describe and construct series and parallel circuits.
 - a. Student handouts, discussion, and student worksheet computer assignment.
 - b. Student handouts, discussion, and student worksheet computer assignment.
 - c. Describe series inductive circuits and pass out worksheet for student to draw and construct circuit. Make time/voltage measurement.

- d. Describe parallel inductive circuits and pass out worksheet for student to draw and construct circuit. Make time/voltage measurement.

Suggested Assessment Strategies:

1. Describe the terms and scientific principles associated with alternating current electricity.
 - a. Written test.
 - b. Oral/written report.
 - c. Oral/written report.
 - d. Oral/written report.
 - e. Oral/written report.
 - f. Oral/written report.
 - g. Oral/written test.
 - h. Oral/written report.
2. Describe and construct series and parallel circuits.
 - a. Observation and completed lab sheets with AC series resistive circuits.
 - b. Observation and completed lab sheets with AC parallel resistive circuits.
 - c. Practical application with lab sheet.
 - d. Practical application with lab sheet.

Standards

Academic Standards

- A5 Utilize various formulas in problem-solving situations.
- A6 Communicate using the language of algebra.
- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP1 Allocates resources (time, money, materials and facilities, and human resources).
- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.

- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools
- T6 Technology problem-solving and decision-making tools

Standards for Electrician Taken from National Center for Construction Education and Research

- ELT1.1 Electrical Safety
- ELT1.4 Electrical Theory One
- ELT1.5 Electrical Theory Two
- ELT1.6 Electrical Test Equipment
- ELT1.9 Conductors

Suggested References

Buban, P., Schmitt, M. L., & Carter, C. G., Jr. (1999). *Electricity and electronics technology*. New York: Glencoe/McGraw-Hill.

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

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Kaltwasser, S., Flowers, G., & Blasingame, D. (1999). *Basic wiring*. Stillwater, OK: Mid-America Vocational Curriculum Consortium.

National electrical code. (2002). Quincy, MA: National Fire Protection Association.

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ELECTRICIAN I**UNIT 7: INTRODUCTION TO RESIDENTIAL WIRING****(85.0 hours)****Competencies and Suggested Objectives:**

1. Discuss the history and future of construction material.
 - a. Interpret the importance of the construction industry.
 - b. Recognize the major historical advancements in the construction industry.
 - c. Describe the advancements in construction equipment and GPS technology.
 - d. Explain the major technological advances in materials used in the construction area such as wood, metal, concrete, brick and mortar, and polymer materials.
2. Identify various residential electrical circuits.
 - a. Diagram various switching circuits to include single pole, three way, and four way.
 - b. Diagram various receptacles to include 120 and 240 circuits.
 - c. Diagram low voltage circuits (i.e., doorbells, thermostats).
2. Wire various residential electrical circuits.
 - a. Wire various switching circuits to include single pole, three way, and four way.
 - b. Wire various receptacles to include 120 and 240 circuits.
 - c. Wire low voltage circuits (i.e., doorbells, thermostats).

Suggested Teaching Strategies:

1. Discuss the history and future of construction material.
 - a. Discuss how the construction industry builds national infrastructure and helps guarantee safe and dependable structures in cities and townships.
 - b. Demonstrate how to build a house of cards. Build the structure on a sheet of card board so that seismic activity may be illustrated after the card house is built. Discuss how construction materials have strengthened buildings making them safer in various seismic and weather conditions.
 - c. Discuss construction equipment and how the machinery has greatly enhanced construction capability and versatility.
 - d. Discuss building materials and their applications in modern construction.
2. Identify various residential electrical circuits.
 - a. Classroom illustrations of how to diagram various switching circuits to include single pole, three way, and four way. Students will perform lab activities.
 - b. Classroom illustrations of how to diagram various receptacles to include 120 and 240 circuits. Students will perform lab activities.
 - c. Classroom illustrations of how to diagram low voltage circuits (i.e., doorbells, thermostats). Students will perform lab activities.

3. Wire various residential electrical circuits.
 - a. Demonstrate how to wire various switching circuits to include single pole, three way, and four way. Students will perform lab activities.
 - b. Demonstrate how to wire various receptacles to include 120 and 240 circuits. Students will perform lab activities.
 - c. Demonstrate how to wire low voltage circuits (i.e., doorbells, thermostats). Students will perform lab activities.

Suggested Assessment Strategies:

1. Identify various residential electrical circuits.
 - a. Oral/written test; checksheet, using a rubric.
 - b. Oral/written test; checksheet, using a rubric.
 - c. Oral/written test; checksheet, using a rubric.
2. Identify various residential electrical circuits.
 - a. Oral/written test; checksheet, using a rubric.
 - b. Oral/written test; checksheet, using a rubric.
 - c. Oral/written test; checksheet, using a rubric.
3. Wire various residential electrical circuits.
 - a. Oral/written test; checksheet, using a rubric.
 - b. Oral/written test; checksheet, using a rubric.
 - c. Oral/written test; checksheet, using a rubric.

Standards

Academic Standards

- A6 Communicate using the language of algebra.
- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools

T6 Technology problem-solving and decision-making tools

Standards for Electrician Taken from National Center for Construction Education and Research

ELT1.1	Electrical Safety
ELT1.2	Hand Bending
ELT1.3	Fasteners and Anchors
ELT1.4	Electrical Theory One
ELT1.6	Electrical Test Equipment
ELT1.7	Introduction to the National Electrical Code®
ELT1.9	Conductors
ELT1.10	Introduction to Electrical Blueprints
ELT1.11	Wiring: Commercial and Industrial
ELT1.12	Wiring Residential

Suggested References

Buban, P., Schmitt, M. L., & Carter, C. G., Jr. (1999). *Electricity and electronics technology*. New York: Glencoe/McGraw-Hill.

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Fletcher, G. (2004). *Residential construction academy house wiring*. Clifton Park, NY: Delmar Thomson Learning.

Herman, S. L. (2004). *Delmar's standard textbook of electricity*. Clifton Park, NY: Delmar Thomson Learning.

Holzman, H. N. (2002). *Modern residential wiring*. Tinley Park, IL: Goodheart Willcox.

Kaltwasser, S., Flowers, G., & Blasingame, D. (1999). *Basic wiring*. Stillwater, OK: Mid-America Vocational Curriculum Consortium.

National electrical code. (2002). Quincy, MA: National Fire Protection Association.

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**ELECTRICIAN I
UNIT 8: BASIC RIGGING**

(20.0 hours)

Competencies and Suggested Objectives:

1. Explain and identify safe rigging and equipment.
 - a. Explain and practice safe rigging.
 - b. Identify and explain rigging equipment.
 - c. Inspect rigging equipment.
2. Identify and explain the use of derricks and cranes.
 - a. Identify, explain, and perform crane hand signals.
 - b. Estimate size, weight, and center of gravity.
 - c. Tie knots.
 - d. Identify and explain types of derricks.
 - e. Identify and explain types of cranes.
 - f. Rig and move materials and equipment.

Suggested Teaching Strategies:

1. Explain and identify safe rigging and equipment.
 - a. Discuss situations where basic rigging is used and stress safety on all aspects of rigging.
 - b. Show students various pieces of rigging equipment and discuss their use.
 - c. Have students identify defects in various pieces of rigging equipment.
2. Identify and explain the use of derricks and cranes.
 - a. Show pictures or transparencies of derricks and cranes; discuss their use on the job. Have students demonstrate crane hand signals.
 - b. Have students estimate size, weight, and center of gravity for pieces of pipe and other equipment in lab.
 - c. Explain the different types of knots and have students demonstrate how to tie them.
 - d. Show pictures or transparencies of derricks and explain their use.
 - e. Show pictures or transparencies of types of cranes and explain their use.
 - f. Visit a job where material and equipment are being rigged and moved.

Suggested Assessment Strategies:

1. Explain and identify safe rigging and equipment.
 - a. Oral/written test.
 - b. Oral/written test.
 - c. Performance test.
2. Identify and explain the use of derricks and cranes.
 - a. Oral/written test.
 - b. Oral/written test.
 - c. Performance test.

- d. Oral/written test.
- e. Oral/written test.
- f. Student observation.

Standards

Academic Standards

- A8 Analyze data and apply concepts of probability.
- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T2 Social, ethical, and human issues

Standards for Electrician Taken from National Center for Construction Education and Research

ELT1.1 Electrical Safety

Suggested References

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Developing safety skills for shop or home. (2002). Winterville, GA: American Association for Vocational Instructional Materials & Tuscaloosa, AL: Resource Center for Technology.

Additional Resources:

Community resource professionals.

Videos:

Safety videos. Available for short-term lease to Mississippi vocational and technical educators from the Research and Curriculum Unit for Workforce Development, P.O. Drawer DX, Mississippi State, MS 39762, Phone: 662-325-2510, Fax: 662-325-3296.

ELECTRICIAN I
UNIT 9: INTRODUCTION TO BLUEPRINTS

(10.0 hours)

Competencies and Suggested Objectives:

1. Identify terms and symbols commonly used on blueprints used in electrical trades.
 - a. Identify symbols used in residential wiring commonly found on blueprints.
 - b. Identify terms used on blueprints.
2. Relate information on prints to real parts and locations.
 - a. Interpret electrical symbols to locate various electrical devices.
 - b. Interpret an electrical plan to determine layout.
 - c. Interpret basic electrical specifications.
3. Identify and apply basic principles of blueprints.
 - a. Explain basic layout of a blueprint.
 - b. Describe the information in a title block.
 - c. Identify the lines used on blueprints.
 - d. Explain the architect=s and engineer=s scales.

Suggested Teaching Strategies:

1. Identify terms and symbols commonly used on blueprints used in electrical trades.
 - a. Review the electrical symbols and have students locate symbols used in residential wiring commonly found on blueprints.
 - b. Use various blueprints and have students discuss terms used on them.
2. Relate information on prints to real parts and locations.
 - a. Use various blueprints and have students distinguish between electrical symbols to locate various electrical devices..
 - b. Use various blueprints and have students analyze an electrical plan to determine layout.
 - c. Use a set of specifications and have students discuss basic electrical specifications.
3. Identify and apply basic principles of blueprints.
 - a. Use a blueprint to illustrate the basic layout of a blueprint.
 - b. Show where the title block is on a blueprint and discuss the information found in it.
 - c. Review the Alphabet of Lines and how various lines are used. Have students compare lines used on the blueprints.
 - d. Discuss the differences in the architect's and engineer's scales.

Suggested Assessment Strategies:

1. Identify terms and symbols commonly used on blueprints used in electrical trades.
 - a. Written test.
 - b. Written test.
2. Relate information on prints to real parts and locations.
 - a. Written test.
 - b. Written test.
 - c. Written test.
3. Identify and apply basic principles of blueprints.
 - a. Written test.
 - b. Written test.
 - c. Written test.
 - d. Written test.

Standards

Academic Standards

- A5 Utilize various formulas in problem-solving situations.
- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP1 Allocates resources (time, money, materials and facilities, and human resources).
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T2 Social, ethical, and human issues
- T5 Technology research tools
- T6 Technology problem-solving and decision-making tools

Standards for Electrician Taken from National Center for Construction Education and Research

- ELT1.1 Electrical Safety
- ELT1.10 Introduction to Electrical Blueprints

Suggested References

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Fletcher, G. (2004). *Residential construction academy house wiring.* Clifton Park, NY: Delmar Thomson Learning.

Herman, S. L. (2004). *Delmar's standard textbook of electricity.* Clifton Park, NY: Delmar Thomson Learning.

Holzman, H. N. (2002). *Modern residential wiring.* Tinley Park, IL: Goodheart Willcox.

Kaltwasser, S., Flowers, G., & Blasingame, D. (1999). *Basic wiring.* Stillwater, OK: Mid-America Vocational Curriculum Consortium.

National electrical code. (2002). Quincy, MA: National Fire Protection Association.

ELECTRICIAN II

ELECTRICIAN II
UNIT 1: BASIC SAFETY (REVIEW)**(8.0 hours)****Competencies and Suggested Objectives:**

1. Review general safety rules for working in a shop/lab and industry.
 - a. Describe how to avoid on-site accidents.
 - b. Explain the relationship between housekeeping and safety.
 - c. Explain the importance of following all safety rules and company safety policies.
 - d. Explain the importance of reporting all on-the-job injuries, accidents, and near misses.
 - e. Explain the need for evacuation policies and the importance of following them.
 - f. Explain the employer=s substance abuse policy and how it relates to their safety.
 - g. Explain the safety procedures when working near pressurized or high temperature systems.
2. Review and apply safety around welding operations.
 - a. Use proper safety practices when welding or working around welding operations.
 - b. Use proper safety practices when welding in or near trenches and excavations.
 - c. Explain the term *proximity work*.
3. Review and explain use of various barriers and confinements.
 - a. Explain the safety requirements for working in confined areas.
 - b. Explain and practice lockout/tagout procedures.
 - c. Explain the different barriers and barricades and how they are used.
 - d. Recognize and explain personal protective equipment.
 - e. Inspect and care for personal protective equipment.
4. Review safe lifting and the use of ladders and scaffolds.
 - a. Identify and explain the procedures for lifting heavy objects.
 - b. Inspect and safely work with various ladders and scaffolds.
5. Review the Material Safety Data Sheets (MSDS).
 - a. Explain the function of the MSDS.
 - b. Interpret the requirements of the MSDS.
6. Review fires.
 - a. Explain the process by which fires start.
 - b. Explain fire prevention of various flammable liquids.
 - c. Explain the classes of fire and the types of extinguishers.
7. Review safety in and around electrical situations.
 - a. Explain injuries when electrical contact occurs.
 - b. Explain safety around electrical hazards.
 - c. Explain action to take when an electrical shock occurs.

Suggested Teaching Strategies:

1. Review general safety rules for working in a shop/lab and industry.
 - a. Give examples from personal experiences or recent accidents that have occurred.
 - b. Conduct a site tour of school pointing out good housekeeping practices and how these practices help make the worksite safe.
 - c. Discuss the school policies on rules of behavior, horseplay, etc., emphasizing the negative consequences of inappropriate behavior.
 - d. Discuss policies on reporting injuries, accidents, and near misses, emphasizing the need to report all injuries and why.
 - e. Describe the evacuation policies of facility and the importance of following these procedures. Emphasize the importance of evacuation on a job site.
 - f. Discuss the employer's substance abuse policy and how it relates to individual's safety.
 - g. Discuss safety guidelines for working near pressurized or high temperature systems. (Use transparencies.)
2. Review and apply safety around welding operations.
 - a. Discuss safety practices to follow when welding or working around welding operations.
 - b. Demonstrate proper safety practices when welding in or near trenches and excavations.
 - c. Escort students around a job site or school facility. Have students identify at least one example of proximity work.
3. Review and explain use of various barriers and confinements.
 - a. Discuss safety requirements for working in confined spaces, emphasizing the fact that confined spaces may contain hazardous gases or fluids.
 - b. Discuss the rules for working with a lockout/tagout system. Show sample tags. Students will respond to questions asked about where these systems may be found on a jobsite.
 - c. Discuss the different types and their uses of barriers or barricades typical to most jobsites.
 - d. Show various pieces of personal protective equipment and explain the purpose of each.
 - e. Discuss both safe and faulty personal protective equipment. Have students inspect each item and identify whether or not it is safe to use.
4. Review safe lifting and the use of ladders and scaffolds.
 - a. Discuss and demonstrate methods to identify and safely lift heavy objects. Under direct supervision of teacher, have students demonstrate how to correctly lift a heavy object.
 - b. Discuss and demonstrate how to inspect and safely work with ladders and scaffolds.
5. Review the Material Safety Data Sheets (MSDS).
 - a. Hand out examples of MSDS and discuss the functions of them.
 - b. Using actual examples of MSDS, discuss the requirements of them.

6. Review fires.
 - a. Discuss how a fire actually starts.
 - b. Discuss fire prevention of various flammable liquids.
 - c. Discuss the four classes of fires, stressing the importance of using the correct fire extinguisher on each fire. Have local fire department representative demonstrate the use of fire extinguishers.
7. Review safety in and around electrical situations.
 - a. Discuss how injuries can occur from electrical contact.
 - b. Discuss and give examples of electrical hazards found on a job site and how to work safely around them.
 - c. Discuss what to do when an electrical shock occurs.

Suggested Assessment Strategies:

1. Review general safety rules for working in a shop/lab and industry.
 - a. Oral and/or written test to determine how to avoid on-site accidents.
 - b. Oral and/or written test to determine the relationship between housekeeping and safety.
 - c. Oral and/or written test to determine the importance of following all safety rules and company safety policies.
 - d. Oral and/or written test to determine the importance of reporting all on-the-job injuries, accidents, and near misses.
 - e. Oral and/or written test and performance exercise.
 - f. Oral and/or written test to determine the employer's substance abuse policy and how it relates to the individual's safety.
 - g. Oral and/or written test to determine the safety procedures when working near pressurized or high temperature systems.
2. Review and apply safety around welding operations.
 - a. Teacher observation and oral/written test to determine proper safety procedures when welding or working around welding operations.
 - b. Teacher observation and oral/written test to determine proper safety procedures when welding in or near trenches and excavations.
 - c. Use a rubric, and oral/written test to determine student identification and definition of proximity work.
3. Review and explain use of various barriers and confinements.
 - a. Teacher observation and oral and/or written test.
 - b. Teacher observation and oral and/or written test.
 - c. Oral and/or written test.
 - d. Teacher observation, written/oral test, using a rubric.
 - e. Teacher observation, written/oral test, using a rubric.
4. Review safe lifting and the use of ladders and scaffolds.
 - a. Teacher observation, written/oral test, using a rubric.
 - b. Teacher observation, written/oral test, using a rubric.
5. Review the Material Safety Data Sheets (MSDS).
 - a. Oral and/or written test.

- b. Oral and/or written test.
- 6. Review fires.
 - a. Oral and/or written test.
 - b. Oral and/or written test.
 - c. Oral and/or written test.
- 7. Review safety in and around electrical situations.
 - a. Oral and/or written test.
 - b. Oral and/or written test.
 - c. Oral and/or written test.

Note: All safety tests must be 100 percent.

Standards

Academic Standards

- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T2 Social, ethical, and human issues
- T3 Technology productivity tools

Standards for Electrician Taken from National Center for Construction Education and Research

- ELT1.1 Electrical Safety
- ELT1.6 Electrical Test Equipment
- ELT1.7 Introduction to the National Electrical Code®

Suggested References

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Developing safety skills for shop or home. (2002). Winterville, GA: American Association for Vocational Instructional Materials & Tuscaloosa, AL: Resource Center for Technology.

Holzman, H. N. (2002). *Modern residential wiring.* Tinley Park, IL: Goodheart Willcox.

Kaltwasser, S., Flowers, G., & Blasingame, D. (1999). *Basic wiring.* Stillwater, OK: Mid-America Vocational Curriculum Consortium.

Local School District Handbook.

National electrical code. (2002). Quincy, MA: National Fire Protection Association.

Additional Resources:

Community resource professionals.

Videos:

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ELECTRICIAN II

UNIT 2: AC CIRCUITS FOR RESIDENTIAL WIRING

(37.5 hours)

Competencies and Suggested Objectives:

1. Determine the type and size of conductors/cables used in the electrical trades.
 - a. Describe factors that determine the type and size of conductors.
 - b. Identify types of cables used in the electrical trades according to National Electrical Code (NEC) and local codes.
2. Determine wiring connections utilizing switching circuits to NEC and local codes.
 - a. Perform sound wiring connections including connectors, terminals, and lugs.
 - b. Describe functions of switches.
3. Determine grounding requirements according to NEC and local codes.
 - a. Perform sound grounding connections as per NEC and/or local codes.
 - b. Test grounding system both mechanically and electrically.

Suggested Teaching Strategies:

1. Determine the type and size of conductors/cables used in the electrical trades.
 - a. Pass out handouts and review terms, types, and sizes.
 - b. Review materials in NEC.
2. Determine wiring connections utilizing switching circuits to NEC and local codes.
 - a. Pass out handouts on wiring connections.
 - b. Demonstrate use of connectors, terminals, and lugs.
3. Determine grounding requirements according to NEC and local codes.
 - a. Distribute handouts on codes.
 - b. Discuss and demonstrate grounding techniques.

Suggested Assessment Strategies:

1. Determine the type and size of conductors/cables used in the electrical trades.
 - a. Oral/written test.
 - b. Oral/written test.
2. Determine wiring connections utilizing switching circuits to NEC and local codes.
 - a. Student demonstration of wiring connections.
 - b. Student demonstration of use of connectors, terminals, and lugs.
3. Determine grounding requirements according to NEC and local codes.
 - a. Student demonstration of typical grounding procedures.
 - b. Oral/written test.

Standards

Academic Standards

- A6 Communicate using the language of algebra.
- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools
- T6 Technology problem-solving and decision-making tools

Standards for Electrician Taken from National Center for Construction Education and Research

ELT1.1	Electrical Safety
ELT1.2	Hand Bending
ELT1.3	Fasteners and Anchors
ELT1.4	Electrical Theory One
ELT1.6	Electrical Test Equipment
ELT1.7	Introduction to the National Electrical Code®
ELT1.9	Conductors
ELT1.10	Introduction to Electrical Blueprints
ELT1.11	Wiring: Commercial and Industrial
ELT1.12	Wiring Residential

Suggested References

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Fletcher, G. (2004). *Residential construction academy house wiring.* Clifton Park, NY: Delmar Thomson Learning.

Herman, S. L. (2004). *Delmar's standard textbook of electricity.* Clifton Park, NY: Delmar Thomson Learning.

Holzman, H. N. (2002). *Modern residential wiring.* Tinley Park, IL: Goodheart Willcox.

Kaltwasser, S., & Flowers, G. (2000). *Commercial and industrial wiring.* Stillwater, OK: Mid-America Vocational Curriculum Consortium.

Kaltwasser, S., Flowers, G., & Blasingame, D. (1999). *Basic wiring.* Stillwater, OK: Mid-America Vocational Curriculum Consortium.

National electrical code. (2002). Quincy, MA: National Fire Protection Association.

ELECTRICIAN II

UNIT 3: LOAD CENTERS AND OVERCURRENT PROTECTION

(7.5 hours)

Competencies and Suggested Objectives:

1. Determine the types of overcurrent protection devices including fuses, circuit breakers, arc fault interrupters, and ground fault circuit interrupters (GFCI) used in safety switches or load centers.
 - a. Describe the types of overcurrent protective devices.
 - b. Identify installations that require GFCI protection according to NEC.
 - c. Identify types of safety switches and load centers.
2. Determine placement of overcurrent protection devices.
 - a. Explain the locations of the devices.
 - b. Recognize the NEC codes pertaining to the placement of overcurrent protection devices.

Suggested Teaching Strategies:

1. Determine the types of overcurrent protection devices including fuses, circuit breakers, arc fault interrupters, and ground fault circuit interrupters (GFCI) used in safety switches or load centers.
 - a. Discuss various types and functions of overcurrent protective devices. Pass out handouts.
 - b. Discuss NEC requirements for GFCI protection in residential and commercial installations.
 - c. Discuss protection devices. Display load centers and safety switches, pointing out differences.
2. Determine placement of overcurrent protection devices.
 - a. Discuss locations of load centers.
 - b. Discuss NEC requirements for load centers and safety switches codes.

Suggested Assessment Strategies:

1. Determine the types of overcurrent protection devices including fuses, circuit breakers, arc fault interrupters, and ground fault circuit interrupters (GFCI) used in safety switches or load centers.
 - a. Written test.
 - b. Oral test.
 - c. Oral test.
2. Determine placement of overcurrent protection devices.
 - a. Oral/written test.
 - b. Oral/written test.

Standards

Academic Standards

- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP1 Allocates resources (time, money, materials and facilities, and human resources).
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools
- T6 Technology problem-solving and decision-making tools

Standards for Electrician Taken from National Center for Construction Education and Research

- ELT1.1 Electrical Safety
- ELT1.2 Hand Bending
- ELT1.3 Fasteners and Anchors
- ELT1.6 Electrical Test Equipment
- ELT1.9 Conductors
- ELT1.12 Wiring Residential

Suggested References

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Developing safety skills for shop or home. (2002). Winterville, GA: American Association for Vocational Instructional Materials & Tuscaloosa, AL: Resource Center for Technology.

Herman, S. L. (2004). *Delmar's standard textbook of electricity.* Clifton Park, NY: Delmar Thomson Learning.

Holzman, H. N. (2002). *Modern residential wiring.* Tinley Park, IL: Goodheart Willcox.

Kaltwasser, S., & Flowers, G. (2000). *Commercial and industrial wiring.* Stillwater, OK: Mid-America Vocational Curriculum Consortium.

Kaltwasser, S., Flowers, G., & Blasingame, D. (1999). *Basic wiring.* Stillwater, OK: Mid-America Vocational Curriculum Consortium.

National electrical code. (2002). Quincy, MA: National Fire Protection Association.

Videos:

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**ELECTRICIAN II
UNIT 4: ROUGH-IN**

(25.0 hours)

Competencies and Suggested Objectives:

1. Determine locations of electrical outlets as shown on the electrical blueprint, according to the NEC.
 - a. Identify locations where at least one receptacle is required.
 - b. Describe planning techniques when placing boxes on plans.
 - c. Explain acceptable heights for boxes in various locations.
 - d. Describe the steps in installing boxes in exterior walls to be brick veneered.
 - e. Describe the required outlets for various living areas in a residence.
2. Wire electrical devices/loads in accordance with NEC and electrical floor plan.
 - a. Install a device box when given cabinet height and wall covering.
 - b. Install a ceiling box when given ceiling covering thickness.
 - c. Wire a 120-volt device or receptacle according to electrical floor plan.
 - d. Wire a 240-volt device or receptacle according to electrical floor plan.

Suggested Teaching Strategies:

1. Determine locations of electrical outlets as shown on the electrical blueprint, according to the NEC.
 - a. Pass out handout.
 - b. Review NEC requirements.
 - c. Discuss planning of receptacles.
 - d. Describe procedures for placing boxes in various residential structures.
 - e. Field trip to residence under construction.
2. Wire electrical devices/loads in accordance with NEC and electrical floor plan.
 - a. Demonstrate how to install a box.
 - b. Demonstrate how to install a ceiling box.
 - c. Demonstrate how to wire a 120-volt.
 - d. Demonstrate how to wire a 240-volt device.

Suggested Assessment Strategies:

1. Determine locations of electrical outlets as shown on the electrical blueprint, according to the NEC.
 - a. Written test.
 - b. Oral/written test.
 - c. Written test.
 - d. Written test.
 - e. Student observation and oral test.
2. Wire electrical device/loads in accordance with NEC and electrical floor plan.
 - a. Observation and checklist.

- b. Observation and checksheet.
- c. Observation and checksheet.
- d. Observation and checksheet.

Standards

Academic Standards

- A8 Analyze data and apply concepts of probability.
- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP1 Allocates resources (time, money, materials and facilities, and human resources).
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools
- T6 Technology problem-solving and decision-making tools

Standards for Electrician Taken from National Center for Construction Education and Research

- ELT1.1 Electrical Safety

Suggested References

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Fletcher, G. (2004). *Residential construction academy house wiring.* Clifton Park, NY: Delmar Thomson Learning.

Herman, S. L. (2004). *Delmar's standard textbook of electricity.* Clifton Park, NY: Delmar Thomson Learning.

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ELECTRICIAN II
UNIT 5: RESIDENTIAL SERVICE

(7.5 hours)

Competencies and Suggested Objectives:

1. Determine service entrance requirements as per NEC.
 - a. Identify parts of a service entrance.
 - b. State clearances for service drops in varying situations.
 - c. Identify the different types of grounding electrodes.
 - d. Describe service requirements for manufactured homes.
2. Install the required service entrance as per NEC.
 - a. Explain the location.
 - b. Describe what material is needed for various service entrances.
 - c. Install the required entrance.

Suggested Teaching Strategies:

1. Determine service entrance requirements as per NEC.
 - a. Discuss parts of a service entrance. Complete handouts.
 - b. Discuss various service drops clearance requirements.
 - c. Discuss types of grounding electrodes.
 - d. Discuss types of service requirements for manufactured homes.
2. Install the required service entrance as per NEC.
 - a. Discuss NEC requirements for location of service entrance equipment.
 - b. Demonstrate how to install overhead raceway with service entrance electrodes through meter base using a minimum of 100 amperes.
 - c. Install the required entrance.

Suggested Assessment Strategies:

1. Determine service entrance requirements as per NEC.
 - a. Written test.
 - b. Written test.
 - c. Written test.
 - d. Written test.
2. Install the required service entrance as per NEC.
 - a. Oral/written test.
 - b. Oral/written test.
 - c. Checklist; students will demonstrate how to lay out service entrance, using checklist.

Standards

Academic Standards

- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP1 Allocates resources (time, money, materials and facilities, and human resources).
- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools
- T6 Technology problem-solving and decision-making tools

Standards for Electrician Taken from National Center for Construction Education and Research

- ELT1.1 Electrical Safety
- ELT1.2 Hand Bending
- ELT1.6 Electrical Test Equipment
- ELT1.8 Raceways, Boxes, & Fittings
- ELT1.12 Wiring Residential

Suggested References

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Fletcher, G. (2004). *Residential construction academy house wiring.* Clifton Park, NY: Delmar Thomson Learning.

Herman, S. L. (2004). *Delmar's standard textbook of electricity.* Clifton Park, NY: Delmar Thomson Learning.

Holzman, H. N. (2002). *Modern residential wiring.* Tinley Park, IL: Goodheart Willcox.

Kaltwasser, S., & Flowers, G. (2000). *Commercial and industrial wiring.* Stillwater, OK: Mid-America Vocational Curriculum Consortium.

Kaltwasser, S., Flowers, G., & Blasingame, D. (1999). *Basic wiring.* Stillwater, OK: Mid-America Vocational Curriculum Consortium.

National electrical code. (2002). Quincy, MA: National Fire Protection Association.

ELECTRICIAN II
UNIT 6: TRIM-OUT AND TROUBLESHOOTING

(27.5 hours)

Competencies and Suggested Objectives:

1. Determine the requirements for electrical trim-out.
 - a. Explain the grounding requirement for appliances.
 - b. Describe steps for panel trim-out.
2. Troubleshoot a residence according to the National Electrical Code (NEC).
 - a. Explain troubleshooting procedures.
 - b. Troubleshoot an electrical circuit.

Suggested Teaching Strategies:

1. Determine the requirements for electrical trim-out.
 - a. Discuss NEC.
 - b. Illustrate the steps for trim-out.
2. Troubleshoot a residence according to the National Electrical Code (NEC).
 - a. Discuss troubleshooting procedures.
 - b. Demonstrate procedures for troubleshooting an electrical system in a residence.

Suggested Assessment Strategies:

1. Determine the requirements for electrical trim-out.
 - a. Written test.
 - b. Performance of the steps in a typical trim-out.
2. Troubleshoot a residence according to the National Electrical Code (NEC).
 - a. Oral/written test.
 - b. Performance checklist on a troubleshooting procedure.

Standards

Academic Standards

- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.

- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP1 Allocates resources (time, money, materials and facilities, and human resources).
- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools
- T6 Technology problem-solving and decision-making tools

Standards for Electrician Taken from National Center for Construction Education and Research

- ELT1.1 Electrical Safety
- ELT1.6 Electrical Test Equipment
- ELT1.10 Introduction to Electrical Blueprints
- ELT1.12 Wiring Residential

Suggested References

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Developing safety skills for shop or home. (2002). Winterville, GA: American Association for Vocational Instructional Materials & Tuscaloosa, AL: Resource Center for Technology.

Herman, S. L. (2004). *Delmar's standard textbook of electricity.* Clifton Park, NY: Delmar Thomson Learning.

Holzman, H. N. (2002). *Modern residential wiring.* Tinley Park, IL: Goodheart Willcox.

Kaltwasser, S., & Flowers, G. (2000). *Commercial and industrial wiring*. Stillwater, OK: Mid-America Vocational Curriculum Consortium.

Kaltwasser, S., Flowers, G., & Blasingame, D. (1999). *Basic wiring*. Stillwater, OK: Mid-America Vocational Curriculum Consortium.

National electrical code. (2002). Quincy, MA: National Fire Protection Association.

Videos:

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**ELECTRICIAN II
UNIT 7: MOTORS AND CONTROLLERS****(27.5 hours)****Competencies and Suggested Objectives:**

1. Demonstrate safe procedures associated with electrical motors in new and existing systems.
 - a. Perform tag and lock procedures.
 - b. Select and install proper overload and overcurrent devices according to NEC.
2. Differentiate between types/classes of electrical motors.
 - a. Explain direct current motor theory of operation including series, shunt, and compound.
 - b. Explain single-phase motor theory of operation including squirrel cage, capacitor start, capacitor run, shaded pole, and repulsion start-induction run.
 - c. Explain three-phase motor operation including squirrel cage, synchronous, and wound rotor along with their voltages, amperages, and nameplate data.
3. Determine speed, direction, and control of AC single- and three-phase and DC motors.
 - a. Reverse rotation of an AC motor, including single-phase and three-phase.
 - b. Wire multi-voltage single- and three-phase electrical motors.
 - c. Wire multi-speed single- and three-phase electrical motors.
4. Identify the physical and electrical characteristics of electrical motors.
 - a. Determine physical and electrical characteristics of electrical motors.
 - b. Determine electrical characteristics using nameplate data and/or NEC requirements.
5. Identify the physical and electrical characteristics of electrical starters.
 - a. Determine physical characteristics including frame size, shaft, environment, and couplings.
 - b. Determine electrical characteristics using nameplate data and/or NEC requirements.
6. Wire single/three-phase electrical motors using manual and automatic controllers/starters with forward/reverse modes.
 - a. Wire single-phase manual/automatic controller for speed control and/or direction.
 - b. Wire three-phase manual/automatic controller for speed control and/or direction.

Suggested Teaching Strategies:

1. Demonstrate safe procedures associated with electrical motors in new and existing systems.
 - a. Discuss tag and lock procedures.

- b. Demonstrate selection and installation of overload and overcurrent devices.
2. Differentiate between types/classes of electrical motors.
 - a. Discuss DC motor theory.
 - b. Discuss single-phase motor theory of operation.
 - c. Discuss three-phase motor operation.
3. Determine speed, direction, and control of AC single- and three-phase and DC motors.
 - a. Demonstrate how to reverse a single-phase and a three-phase motor.
 - b. Demonstrate how to wire multi-voltage single- and three-phase motors.
 - c. Demonstrate how to wire single- and three-phase motors.
4. Identify the physical and electrical characteristics of electrical starters.
 - a. Discussion of the physical and electrical characteristics.
 - b. Discussion of nameplate data.
5. Identify the physical and electrical characteristics of electrical starters.
 - a. Discussion of parts.
 - b. Review NEC.
6. Wire single/three-phase electrical motors using manual and automatic controllers/starters with forward/reverse modes.
 - a. Demonstrate wiring the motors.
 - b. Mock-up.

Suggested Assessment Strategies:

1. Demonstrate safe procedures associated with electrical motors in new and existing systems.
 - a. Written test on NEC.
 - b. Written test.
2. Differentiate between types/classes of electrical motors.
 - a. Oral test.
 - b. Oral test.
 - c. Oral test.
3. Determine speed, direction, and control of AC single- and three-phase and DC motors.
 - a. Written test.
 - b. Application using a checklist.
 - c. Application using a checklist.
4. Identify the physical and electrical characteristics of electrical motors.
 - a. Written test.
 - b. Written test.
5. Identify the physical and electrical characteristics of electrical starters.
 - a. Written test.
 - b. Written test.
6. Wire single/three-phase electrical motors using manual and automatic controllers/starters with forward/reverse modes.
 - a. Application using a checklist.

- b. Application using a checklist.

Standards

Academic Standards

- A5 Utilize various formulas in problem-solving situations.
- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools
- T6 Technology problem-solving and decision-making tools

Standards for Electrician Taken from National Center for Construction Education and Research

- ELT1.1 Electrical Safety
- ELT1.2 Hand Bending
- ELT1.8 Raceways, Boxes, & Fittings
- ELT1.9 Conductors
- ELT1.10 Introduction to Electrical Blueprints

ELT1.11 Wiring: Commercial and Industrial

Suggested References

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Developing safety skills for shop or home. (2002). Winterville, GA: American Association for Vocational Instructional Materials & Tuscaloosa, AL: Resource Center for Technology.

Herman, S. L. (2004). *Delmar's standard textbook of electricity.* Clifton Park, NY: Delmar Thomson Learning.

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**ELECTRICIAN II
UNIT 8: INTRODUCTION TO PROGRAMMABLE
LOGIC CONTROLLERS (PLC)**

(20.0 hours)

Competencies and Suggested Objectives:

1. Describe function of programmable logic controls (PLC).
 - a. Define terms associated with programmable logic controls including digital, analog signal, counter, discrete, fiber optics, input, logic, networking, output, programmer, and programmable logic controller.
 - b. Explain programmable logic controller functions including input and output signal compared to previously programmed instructions.
 - c. Identify input devices for programmable logic controllers including pushbutton switches, limit switches, proximity switches, timers, photoelectric cells, and flow switches.
 - d. Identify output devices for programmable logic controllers including motor starters, contractors, solenoids, pilot lights, and coil relays.
2. Describe application of programmable logic controls.
 - a. Write a basic PLC program including two and three wire controls.
 - b. Wire a PLC input device including pushbutton switches, limit switches, proximity switches, timers, photoelectric cells, and flow switches.
 - c. Wire a PLC output device including timers, pilot lights, brakes, solenoids, starter motors, contractors, and coil relays.

Suggested Teaching Strategies:

1. Describe function of programmable logic controls (PLC).
 - a. Discussion of terms.
 - b. Discussion of the PLC functions.
 - c. Demonstration and discussion of input devices.
 - d. Demonstration and discussion of output devices.
2. Describe application of programmable logic controls.
 - a. Demonstrate how to write a basic PLC program for two and three wire controls.
 - b. Demonstration and discussion of wiring a PLC input device.
 - c. Demonstration and discussion of wiring a PLC output device.

Suggested Assessment Strategies:

1. Describe function of programmable logic control (PLC)
 - a. Written test.
 - b. Written test.
 - c. Application using a checksheet.
 - d. Written test.

2. Describe application of programmable logic controls.
 - a. Application using a checklist.
 - b. Written test.
 - c. Written test.

Standards

Academic Standards

- A5 Utilize various formulas in problem-solving situations.
- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools
- T6 Technology problem-solving and decision-making tools

Standards for Electrician Taken from National Center for Construction Education and Research

- ELT1.1 Electrical Safety
- ELT1.9 Conductors

ELT1.11 Wiring: Commercial and Industrial

Suggested References

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Herman, S. L. (2004). *Delmar's standard textbook of electricity.* Clifton Park, NY: Delmar Thomson Learning.

Kaltwasser, S., & Flowers, G. (2000). *Commercial and industrial wiring.* Stillwater, OK: Mid-America Vocational Curriculum Consortium.

Kaltwasser, S., Flowers, G., & Blasingame, D. (1999). *Basic wiring.* Stillwater, OK: Mid-America Vocational Curriculum Consortium.

National electrical code. (2002). Quincy, MA: National Fire Protection Association.

ELECTRICIAN II
UNIT 9: COMMERCIAL AND INDUSTRIAL WIRING**(42.5 hours)****Competencies and Suggested Objectives:**

1. Demonstrate hand bending procedures.
 - a. Identify the methods of hand bending conduit.
 - b. Identify the various methods used to install conduit.
 - c. Use math to determine conduit bends.
 - d. Make different bends by using a hand bender.
2. Identify and install fasteners and anchors.
 - a. Identify and explain the use of threaded fasteners.
 - b. Identify and explain the use of non-threaded fasteners.
 - c. Identify and explain the use of various anchors.
 - d. Install fasteners and anchors.
3. Identify and install various raceways, boxes, and fittings.
 - a. Identify various types of cable trays and raceways.
 - b. Identify and select various types and sizes of raceways.
 - c. Identify and select various types and sizes of cable trays.
 - d. Identify and select various types of raceway fittings.
 - e. Describe procedures for installing raceways and boxes on masonry surfaces.
 - f. Describe procedures for installing raceways and boxes on concrete surfaces.
 - g. Describe procedures for installing raceways and boxes in a metal stud environment.
 - h. Follow safety precautions when working with boxes and raceways.
4. Explain, identify, and perform various functions of commercial and industrial wiring.
 - a. Explain National Electrical Manufacturers Association (NEMA) classifications of switches and enclosures.
 - b. Explain National Electrical Code (NEC) codes on wiring devices.
 - c. Identify and state the functions and ratings of various receptacles.
 - d. Identify and define receptacle terminals and disconnects.
 - e. Explain ground fault circuit interrupters (GFCI).
 - f. Use a wire stripper to strip a wire.
 - g. Use a solderless connector to splice wires.
 - h. Identify and state the functions of limit switches and relays.
 - i. Identify and state the functions of switchgear.

Suggested Teaching Strategies:

1. Demonstrate hand bending procedures.
 - a. Emphasize familiarity of bender and proper bending techniques.

- b. Discuss the use of straps, hangers, clamps, and NEC guidelines when installing conduit. (Install conduit using various chips or hangers according to NEC standards.)
 - c. Discuss the importance of math as it relates to proper conduit bending.
 - d. Demonstrate stub-up, three point saddle, four point saddle, back to back, and box offset bends. Have students practice making various bends.
2. Identify and install fasteners and anchors.
 - a. Discuss threaded fasteners and their applications. Show examples.
 - b. Discuss non-threaded fasteners and their applications. Show examples.
 - c. Discuss various anchors and their applications. Show examples.
 - d. Have students install various fasteners and anchors.
 3. Identify and install various raceways, boxes, and fittings.
 - a. Discuss various types of raceways, cable trays and their applications.
 - b. Discuss considerations involved in selecting and sizing raceways.
 - c. Discuss considerations involved in selecting and sizing cable trays.
 - d. Discuss applications of various fittings. Show examples.
 - e. Install raceway and boxes in a masonry structure.
 - f. Discuss procedures involved in installing boxes in concrete structures.
 - g. Discuss procedures for installing raceways and boxes in metal stud environments. Do mockups.
 - h. Demonstrate safety precautions used when working with boxes and raceways.
 4. Explain, identify, and perform various functions of commercial and industrial wiring.
 - a. Discuss the NEMA switch classifications.
 - b. Discuss relevant NEC articles on wiring devices.
 - c. Discuss various types of receptacles and their applications.
 - d. Discuss color coded receptacle terminals. Show examples.
 - e. Discuss GFCI's and their importance.
 - f. Demonstrate the use of a wire stripper.
 - g. Demonstrate how to use a solderless connector to splice wires.
 - h. Discuss limit switches and their applications. Show examples.
 - i. Discuss switchgear and its applications.

Suggested Assessment Strategies:

1. Demonstrate hand bending procedures.
 - a. Written/oral test.
 - b. Written/oral test.
 - c. Written/oral test.
 - d. Application.
2. Identify and install fasteners and anchors.
 - a. Written/oral test.
 - b. Written/oral test.
 - c. Written/oral test.
 - d. Written/oral test.

3. Identify and install various raceways, boxes, and fittings.
 - a. Written/oral test.
 - b. Written/oral test.
 - c. Written/oral test.
 - e. Written/oral test.
 - f. Written/oral test.
 - f. Written/oral test.
 - g. Written/oral test.
 - h. Written/oral test. **100 percent accurate**
4. Explain, identify, and perform various functions of commercial and industrial wiring.
 - a. Written/oral test.
 - b. Written/oral test.
 - c. Written/oral test.
 - d. Written/oral test.
 - e. Written/oral test.
 - f. Performance.
 - g. Performance.
 - h. Written/oral test.
 - i. Written/oral test.

Standards

Academic Standards

- A5 Utilize various formulas in problem-solving situations.
- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

Workplace Skills

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.

- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools
- T6 Technology problem-solving and decision-making tools

Standards for Electrician Taken from National Center for Construction Education and Research

- ELT1.1 Electrical Safety
- ELT1.2 Hand Bending
- ELT1.3 Fasteners and Anchors
- ELT1.6 Electrical Test Equipment
- ELT1.8 Raceways, Boxes, & Fittings
- ELT1.9 Conductors
- ELT1.11 Wiring: Commercial and Industrial

Suggested References

Construction and maintenance curricula: Core curriculum. (2000). Gainesville, FL: National Center for Construction Education and Research.

Developing safety skills for shop or home. (2002). Winterville, GA: American Association for Vocational Instructional Materials & Tuscaloosa, AL: Resource Center for Technology.

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SECTION II:
CURRICULUM FRAMEWORK
FOR
ELECTRICIAN

CURRICULUM FRAMEWORK

Course Name: Electrician I

Course CIP Code: 46.0302

Course Description: Electrician I is the entry level course of the secondary Electrician program. Students in this course will gain foundation competencies related to orientation, safety, math, hand and power tools, direct current circuits, alternating current circuits, basic rigging, and introduction to blueprints. (2-2½ Carnegie units, depending upon time spent in the course)

Competencies and Suggested Objectives:

1. Describe local program and vocational center policies and procedures.
 - a. Describe local program and vocational center policies and procedures including dress code, attendance, academic requirements, discipline, shop/lab rules and regulations, and transportation regulations.
2. Describe employment opportunities and responsibilities for electricians and related employees.
 - a. Describe employment opportunities available for electricians, electronics technicians, and electrical related employees including potential earnings, employee benefits, job availability, possible places of employment, working conditions, and educational requirements.
 - b. Describe basic employee responsibilities including punctuality, physical requirements, customer relations, following directions, job safety, and entry level skills.
3. State procedures of leadership used to reach an agreement in an orderly manner and personal development opportunities provided students in electricity trades by SkillsUSA.
 - a. State procedures of leadership used in organizational meetings to reach an agreement in an orderly manner including procedures for gaining recognition in a meeting and conducting a SkillsUSA Club meeting.
 - b. Describe the purposes of SkillsUSA including leadership development, personal development, and skills competition.
4. Describe general safety rules for working in a shop/lab and industry.
 - a. Describe how to avoid on-site accidents.
 - b. Explain the relationship between housekeeping and safety.
 - c. Explain the importance of following all safety rules and company safety policies.
 - d. Explain the importance of reporting all on-the-job injuries, accidents, and near misses.
 - e. Explain the need for evacuation policies and the importance of following them.
 - f. Explain the employer=s substance abuse policy and how it relates to their safety.

14. Explain the procedures for the maintenance of power tools.
 - a. Explain preventive maintenance.
 - b. Explain the procedures for the maintenance of power tools.
 - c. Demonstrate how to perform maintenance of power tools.
15. Describe the terms and scientific principles associated with direct current electricity.
 - a. Define terms associated with the nature of matter including physical characteristics of matter (elements, compounds, atoms, electrons, protons, and neutrons).
 - b. Describe laws of electrical charges including like and unlike charges.
 - c. Identify electrical materials including conductors, insulators, and semiconductors.
 - d. Describe methods of generating electricity including solar, chemical, mechanical, and thermal.
 - e. Describe the principles and operation of batteries.
 - f. Describe basic theories of current flow including electron and conventional flow methods.
 - g. Describe DC circuit parameters including voltage, power, current, and resistance.
 - h. Identify resistor types and values using standard resistor color codes and alphanumeric codes.
 - i. Perform basic engineering notation calculations including conversion, adding, subtracting, multiplying, and dividing.
 - j. Identify DC circuit schematic symbols.
16. Create circuits and measure DC electricity using the multimeter.
 - a. Describe and demonstrate use of a multimeter including measuring voltage, current, and resistance.
 - b. Demonstrate use of Ohm's Law to calculate circuit parameters for a series circuit including voltage, current, resistance, and power.
 - c. Draw and construct a series circuit with a minimum of three resistances.
 - d. Calculate and measure circuit parameters for a series circuit.
 - e. Demonstrate use of Ohm's Law to calculate circuit parameters for a parallel circuit including voltage, current, resistance, and power.
 - f. Draw and construct a parallel circuit with a minimum of three resistances.
 - g. Calculate and measure circuit parameters for a parallel circuit.
 - h. Demonstrate use of Ohm's Law to calculate circuit parameters for a series-parallel circuit including voltage, current, resistance, and power.
 - i. Draw and construct a series-parallel circuit with a minimum of three resistances.
 - j. Calculate and measure circuit parameters for a series-parallel circuit.
17. Describe the principles of magnetism and electromagnetic properties.
 - a. Describe the principles of magnetism including magnetic fields, polarities, core materials, permeability, motor action, induced current, and associated laws.

- b. Describe the principles of electromagnetic properties including magnetic fields, polarities, core materials, permeability, motor action, induced current, and associated laws.
 - c. Construct a simple electromagnet, including use of copper windings and a metal rod.
18. Describe the terms and scientific principles associated with alternating current electricity.
- a. Describe principles of AC generation.
 - b. Define terms associated with AC voltage.
 - c. Describe sources of AC voltage.
 - d. Describe distribution route and components used from power plant to home or business.
 - e. Describe the properties and characteristics of inductors.
 - f. Describe the properties and characteristics of transformers.
 - g. Describe properties and characteristics of capacitors.
 - h. Describe differences in phases in electrical power supply.
19. Describe and construct series and parallel circuits.
- a. Draw and construct a series resistive circuit, calculating parameters and discussing phase relationship.
 - b. Draw and construct a parallel resistive circuit, calculating parameters and discussing phase relationship.
 - c. Draw and construct a series inductive circuit.
 - d. Draw and construct a parallel inductive circuit.
20. Identify various residential electrical circuits.
- a. Diagram various switching circuits to include single pole, three way, and four way.
 - b. Diagram various receptacles to include 120 and 240 circuits.
 - c. Diagram low voltage circuits (i.e., doorbells, thermostats).
21. Wire various residential electrical circuits.
- a. Wire various switching circuits to include single pole, three way, and four way.
 - b. Wire various receptacles to include 120 and 240 circuits.
 - c. Wire low voltage circuits (i.e., doorbells, thermostats).
22. Explain and identify safe rigging and equipment.
- a. Explain and practice safe rigging.
 - b. Identify and explain rigging equipment.
 - c. Inspect rigging equipment.
23. Identify and explain the use of derricks and cranes.
- a. Identify, explain, and perform crane hand signals.
 - b. Estimate size, weight, and center of gravity.
 - c. Tie knots.
 - d. Identify and explain types of derricks.
 - e. Identify and explain types of cranes.
 - f. Rig and move materials and equipment.

24. Identify terms and symbols commonly used on blueprints used in electrical trades.
 - a. Identify symbols used in residential wiring commonly found on blueprints.
 - b. Identify terms used on blueprints.
25. Relate information on prints to real parts and locations.
 - a. Interpret electrical symbols to locate various electrical devices.
 - b. Interpret an electrical plan to determine layout.
 - c. Interpret basic electrical specifications.
26. Identify and apply basic principles of blueprints.
 - a. Explain basic layout of a blueprint.
 - b. Describe the information in a title block.
 - c. Identify the lines used on blueprints.
 - d. Explain the architect's and engineer's scales.

CURRICULUM FRAMEWORK

Course Name: Electrician II

Course CIP Code: 46.0390

Course Description: Electrician II is the advanced course of the secondary Electrician program. Students in this course will gain additional competencies related to safety, leadership, AC circuits for residential wiring, load centers and overcurrent protection, rough-in, residential service, trim-out and troubleshooting, motors and controllers, programmable logic controllers, employment skills, and commercial and industrial wiring. (2-2½ Carnegie units, depending upon time spent in the course)

Competencies and Suggested Objectives:

1. Review general safety rules for working in a shop/lab and industry.
 - a. Describe how to avoid on-site accidents.
 - b. Explain the relationship between housekeeping and safety.
 - c. Explain the importance of following all safety rules and company safety policies.
 - d. Explain the importance of reporting all on-the-job injuries, accidents, and near misses.
 - e. Explain the need for evacuation policies and the importance of following them.
 - f. Explain the employer=s substance abuse policy and how it relates to their safety.
 - g. Explain the safety procedures when working near pressurized or high temperature systems.
2. Review and apply safety around welding operations.
 - a. Use proper safety practices when welding or working around welding operations.
 - b. Use proper safety practices when welding in or near trenches and excavations.
 - c. Explain the term *proximity work*.
3. Review and explain use of various barriers and confinements.
 - a. Explain the safety requirements for working in confined areas.
 - b. Explain and practice lockout/tagout procedures.
 - c. Explain the different barriers and barricades and how they are used.
 - d. Recognize and explain personal protective equipment.
 - e. Inspect and care for personal protective equipment.
4. Review safe lifting and the use of ladders and scaffolds.
 - a. Identify and explain the procedures for lifting heavy objects.
 - b. Inspect and safely work with various ladders and scaffolds.
5. Review the Material Safety Data Sheets (MSDS).
 - a. Explain the function of the MSDS.

- b. Interpret the requirements of the MSDS.
6. Review fires.
 - a. Explain the process by which fires start.
 - b. Explain fire prevention of various flammable liquids.
 - c. Explain the classes of fire and the types of extinguishers.
7. Review safety in and around electrical situations.
 - a. Explain injuries when electrical contact occurs.
 - b. Explain safety around electrical hazards.
 - c. Explain action to take when an electrical shock occurs.
8. Determine the type and size of conductors/cables used in the electrical trades.
 - a. Describe factors that determine the type and size of conductors.
 - b. Identify types of cables used in the electrical trades according to National Electrical Code (NEC) and local codes.
9. Determine wiring connections utilizing switching circuits to NEC and local codes.
 - a. Perform sound wiring connections including connectors, terminals, and lugs.
 - b. Describe functions of switches.
10. Determine grounding requirements according to NEC and local codes.
 - a. Perform sound grounding connections as per NEC and/or local codes.
 - b. Test grounding system both mechanically and electrically.
11. Determine the types of overcurrent protection devices including fuses, circuit breakers, arc fault interrupters, and ground fault circuit interrupters (GFCI) used in safety switches or load centers.
 - a. Describe the types of overcurrent protective devices.
 - b. Identify installations that require GFCI protection according to NEC.
 - c. Identify types of safety switches and load centers.
12. Determine placement of overcurrent protection devices.
 - a. Explain the locations of the devices.
 - b. Recognize the NEC codes pertaining to the placement of overcurrent protection devices.
13. Determine locations of electrical outlets as shown on the electrical blueprint, according to the NEC.
 - a. Identify locations where at least one receptacle is required.
 - b. Describe planning techniques when placing boxes on plans.
 - c. Explain acceptable heights for boxes in various locations.
 - d. Describe the steps in installing boxes in exterior walls to be brick veneered.
 - e. Describe the required outlets for various living areas in a residence.
14. Wire electrical devices/loads in accordance with NEC and electrical floor plan.
 - a. Install a device box when given cabinet height and wall covering.
 - b. Install a ceiling box when given ceiling covering thickness.
 - c. Wire a 120-volt device or receptacle according to electrical floor plan.
 - d. Wire a 240-volt device or receptacle according to electrical floor plan.
15. Determine service entrance requirements as per NEC.
 - a. Identify parts of a service entrance.
 - b. State clearances for service drops in varying situations.

- c. Identify the different types of grounding electrodes.
- d. Describe service requirements for manufactured homes.
- 16. Install the required service entrance as per NEC.
 - a. Explain the location.
 - b. Describe what material is needed for various service entrances.
 - c. Install the required entrance.
- 17. Determine the requirements for electrical trim-out.
 - a. Explain the grounding requirement for appliances.
 - b. Describe steps for panel trim-out.
- 18. Troubleshoot a residence according to the National Electrical Code (NEC).
 - a. Explain troubleshooting procedures.
 - b. Troubleshoot an electrical circuit.
- 19. Demonstrate safe procedures associated with electrical motors in new and existing systems.
 - a. Perform tag and lock procedures.
 - b. Select and install proper overload and overcurrent devices according to NEC.
- 20. Differentiate between types/classes of electrical motors.
 - a. Explain direct current motor theory of operation including series, shunt, and compound.
 - b. Explain single-phase motor theory of operation including squirrel cage, capacitor start, capacitor run, shaded pole, and repulsion start-induction run.
 - c. Explain three-phase motor operation including squirrel cage, synchronous, and wound rotor along with their voltages, amperages, and nameplate data.
- 21. Determine speed, direction, and control of AC single- and three-phase and DC motors.
 - a. Reverse rotation of an AC motor, including single-phase and three-phase.
 - b. Wire multi-voltage single- and three-phase electrical motors.
 - c. Wire multi-speed single- and three-phase electrical motors.
- 22. Identify the physical and electrical characteristics of electrical motors.
 - a. Determine physical and electrical characteristics of electrical motors.
 - b. Determine electrical characteristics using nameplate data and/or NEC requirements.
- 23. Identify the physical and electrical characteristics of electrical starters.
 - a. Determine physical characteristics including frame size, shaft, environment, and couplings.
 - b. Determine electrical characteristics using nameplate data and/or NEC requirements.
- 24. Wire single/three-phase electrical motors using manual and automatic controllers/starters with forward/reverse modes.
 - a. Wire single-phase manual/automatic controller for speed control and/or direction.
 - b. Wire three-phase manual/automatic controller for speed control and/or direction.

25. Describe function of programmable logic controls (PLC)..
 - a. Define terms associated with programmable logic controls including digital, analog signal, counter, discrete, fiber optics, input, logic, networking, output, programmer, and programmable logic controller.
 - b. Explain programmable logic controller functions including input and output signal compared to previously programmed instructions.
 - c. Identify input devices for programmable logic controllers including pushbutton switches, limit switches, proximity switches, timers, photoelectric cells, and flow switches.
 - d. Identify output devices for programmable logic controllers including motor starters, contractors, solenoids, pilot lights, and coil relays.
26. Describe application of programmable logic controls.
 - a. Write a basic PLC program including two and three wire controls.
 - b. Wire a PLC input device including pushbutton switches, limit switches, proximity switches, timers, photoelectric cells, and flow switches.
 - c. Wire a PLC output device including timers, pilot lights, brakes, solenoids, starter motors, contractors, and coil relays.
27. Demonstrate hand bending procedures.
 - a. Identify the methods of hand bending conduit.
 - b. Identify the various methods used to install conduit.
 - c. Use math to determine conduit bends.
 - d. Make different bends by using a hand bender.
28. Identify and install fasteners and anchors.
 - a. Identify and explain the use of threaded fasteners.
 - b. Identify and explain the use of non-threaded fasteners.
 - c. Identify and explain the use of various anchors.
 - d. Install fasteners and anchors.
29. Identify and install various raceways, boxes, and fittings.
 - a. Identify various types of cable trays and raceways.
 - b. Identify and select various types and sizes of raceways.
 - c. Identify and select various types and sizes of cable trays.
 - d. Identify and select various types of raceway fittings.
 - e. Describe procedures for installing raceways and boxes on masonry surfaces.
 - f. Describe procedures for installing raceways and boxes on concrete surfaces.
 - g. Describe procedures for installing raceways and boxes in a metal stud environment.
 - h. Follow safety precautions when working with boxes and raceways.
30. Explain, identify, and perform various functions of commercial and industrial wiring.
 - a. Explain National Electrical Manufacturers Association (NEMA) classifications of switches and enclosures.
 - b. Explain National Electrical Code (NEC) codes on wiring devices.
 - c. Identify and state the functions and ratings of various receptacles.

- d. Identify and define receptacle terminals and disconnects.
- e. Explain ground fault circuit interrupters (GFCI).
- f. Use a wire stripper to strip a wire.
- g. Use a solderless connector to splice wires.
- h. Identify and state the functions of limit switches and relays.
- i. Identify and state the functions of switchgear.

SECTION III:
RECOMMENDED TOOLS AND EQUIPMENT

RECOMMENDED TOOLS AND EQUIPMENT
FOR
ELECTRICIAN

1. Rule, folding (10)
2. Screwdriver set, flat blade (10)
3. Screwdriver set, Phillips (10)
4. Pliers, slip-joint (10)
5. Wrench, channel-lock (10)
6. Hammer, ball peen (10)
7. Hacksaw (5)
8. Saw, keyhole (10)
9. File set (2)
10. Chisel (10)
11. Center punch (10)
12. Bolt cutter (1)
13. Hex key set (10)
14. Magnetic torpedo level (10)
15. Knockout punch set (1)
16. Hole saw and arbor set (1)
17. Drill brace (2)
18. Ship auger drill bit set (2)
19. Tap tool (10)
20. Electric drill, 3/8" (reversible, variable speed) (1)
21. Electric drill, 1/2" (reversible, variable speed) (1)
22. Battery powered drill driver w/1/2" keyless chuck (1)
23. Drill bit set (2)
24. Reciprocating saw (1)
25. Screw holding screwdriver, large (1)
26. Screw holding screwdriver, small (1)
27. Needle nose pliers (20)
28. Lineman's pliers (10)
29. Soldering iron (25w) (10)
30. Adjustable wire strippers (10)
31. Cutting/crimping tool (10)
32. Tool pouch (10)
33. Circuit tester (10)
34. Conduit reamer (1)
35. Nut driver set (10)
36. Cable bender (1)
37. Fuse puller (10)
38. Safety glasses and goggles (1/student)
39. Electrician's hammer (10)
40. Cable cutter (1)
41. Heat gun (1300w) (1)

42. Drop chain (1)
43. Steel fish tape and reel (1)
44. Pulling grip-sleeve set (1)
45. Pipe reamer (1)
46. Combination conduit/EMT bender set (1)
47. Hickey bender set (1)
48. Electrician's knife (10)
49. Rubber gloves (1 pair/10 students)
50. Torque screwdriver set (10)
51. Torque wrench (1)
52. Rubber hose (line hose) (1)
53. Rubber blanket (1)
54. DC power source (10)
55. Electrical resistance/insulation tester (1)
56. Ground fault tester (1)
57. Isolation transformer (10)
58. Multimeters (digital and analog) (10)
59. Soldering/desoldering equipment (10)
60. Voltage isolation transformers (adjustable) (5)
61. Drill press (1)
62. Architect's scales (10)
63. Clamp-on amp meters (5)
64. Megometer (1)
65. Hammer-drill (1)
66. PLC (1 min)
67. Single phase motors (3)
 - Two speed (1)
 - Dual voltage (1)
 - Reversing (1)
68. Three-phase motors (3)
 - Two-speed (1)
 - Dual voltage (1)
 - Reversing (1)
69. Single-phase controllers (2)
 - Two-speed (1)
 - Reversing (1)
70. Full voltage magnetic three-phase controllers (2)
 - Two speed (1)
 - Reversing (1)
71. Full voltage magnetic controller (1)
72. Ripping bar
73. Nail puller
74. Sledge hammer
75. Framing square
76. Combination square
77. Wire brush

78. Adjustable wrench
79. Open-end wrenches
80. Box-end wrenches
81. Combination wrench
82. C-clamp (5)
83. Rip saw (3)
84. Plumb bobs (5)
85. Sockets (3 sets with ½ inch drive)
86. Sockets (3 sets with 3/8 inch drive)
87. Wedges (Assortment)
88. Chalk line (5)
89. Chain fall (3)
90. Come along (3)
91. Angle grinder (2)
92. Pneumatic drills (3)
93. End grinder
94. Circular saw
95. Portable hand-held jig saw
96. Bench grinder

RECOMMENDED INSTRUCTIONAL AIDS

Recommended that teachers have access to:

1. Scientific calculator (1)
2. Cart, AV (for overhead projector) (1)
3. Cart, AV (for TV-VCR) (1)
4. Computer with operating software with multimedia kit (1)
5. Projector, overhead (1)
6. TV-VCR (1)
7. Video out (microcomputer to TV monitor) (1)
8. Video/audio data projector (1)

May 21, 2004

APPENDIX A:
RELATED ACADEMIC TOPICS

May 21, 2004

ALGEBRA I

Competencies and Suggested Objective(s)

A1. Recognize, classify, and use real numbers and their properties.

- a. Describe the real number system using a diagram to show the relationships of component sets of numbers that compose the set of real numbers.
- b. Model properties and equivalence relationships of real numbers.
- c. Demonstrate and apply properties of real numbers to algebraic expressions.
- d. Perform basic operations on square roots excluding rationalizing denominators.

A2. Recognize, create, extend, and apply patterns, relations, and functions and their applications.

- a. Analyze relationships between two variables, identify domain and range, and determine whether a relation is a function.
- b. Explain and illustrate how change in one variable may result in a change in another variable.
- c. Determine the rule that describes a pattern and determine the pattern given the rule.
- d. Apply patterns to graphs and use appropriate technology.

A3. Simplify algebraic expressions, solve and graph equations, inequalities and systems in one and two variables.

- a. Solve, check, and graph linear equations and inequalities in one variable, including rational coefficients.
- b. Graph and check linear equations and inequalities in two variables.
- c. Solve and graph absolute value equations and inequalities in one variable.
- d. Use algebraic and graphical methods to solve systems of linear equations and inequalities.
- e. Translate problem-solving situations into algebraic sentences and determine solutions.

A4. Explore and communicate the characteristics and operations of polynomials.

- a. Classify polynomials and determine the degree.
- b. Add, subtract, multiply, and divide polynomial expressions.
- c. Factor polynomials using algebraic methods and geometric models
- d. Investigate and apply real-number solutions to quadratic equations algebraically and graphically.

- e. Use convincing arguments to justify unfactorable polynomials.
- f. Apply polynomial operations to problems involving perimeter and area.

A5. Utilize various formulas in problem-solving situations.

- a. Evaluate and apply formulas (e.g., circumference, perimeter, area, volume, Pythagorean Theorem, interest, distance, rate, and time).
- b. Reinforce formulas experimentally to verify solutions.
- c. Given a literal equation, solve for any variable of degree one.
- d. Using the appropriate formula, determine the length, midpoint, and slope of a segment in a coordinate plane.
- e. Use formulas (e.g., point-slope and slope-intercept) to write equations of lines.

A6. Communicate using the language of algebra.

- a. Recognize and demonstrate the appropriate use of terms, symbols, and notations.
- b. Distinguish between linear and non-linear equations.
- c. Translate between verbal expressions and algebraic expressions.
- d. Apply the operations of addition, subtraction, and scalar multiplication to matrices.
- e. Use scientific notation to solve problems.
- f. Use appropriate algebraic language to justify solutions and processes used in solving problems.

A7. Interpret and apply slope as a rate of change.

- a. Define slope as a rate of change using algebraic and geometric representations.
- b. Interpret and apply slope as a rate of change in problem-solving situations.
- c. Use ratio and proportion to solve problems including direct variation ($y=kx$).
- d. Apply the concept of slope to parallel and perpendicular lines.

A8. Analyze data and apply concepts of probability.

- a. Collect, organize, graph, and interpret data sets, draw conclusions, and make predictions from the analysis of data.
- b. Define event and sample spaces and apply to simple probability problems.
- c. Use counting techniques, permutations, and combinations to solve probability problems.

BIOLOGY I

Competencies and Suggested Objective(s)

B1. Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

- a. Demonstrate the proper use and care for scientific equipment used in biology.
- b. Observe and practice safe procedures in the classroom and laboratory.
- c. Apply the components of scientific processes and methods in the classroom and laboratory investigations.
- d. Communicate results of scientific investigations in oral, written, and graphic form.

B2. Investigate the biochemical basis of life.

- a. Identify the characteristics of living things.
- b. Describe and differentiate between covalent and ionic bonds using examples of each.
- c. Describe the unique bonding and characteristics of water that makes it an essential component of living systems.
- d. Classify solutions using the pH scale and relate the importance of pH to organism survival.
- e. Compare the structure, properties and functions of carbohydrates, lipids, proteins and nucleic acids in living organisms.
- f. Explain how enzymes work and identify factors that can affect enzyme action.

B3. Investigate cell structures, functions, and methods of reproduction.

- a. Differentiate between prokaryotic and eukaryotic cells.
- b. Distinguish between plant and animal (eukaryotic) cell structures.
- c. Identify and describe the structure and basic functions of the major eukaryotic organelles.
- d. Describe the way in which cells are organized in multicellular organisms.
- e. Relate cell membrane structure to its function in passive and active transport.
- f. Describe the main events in the cell cycle and cell mitosis including differences in plant and animal cell divisions.
- g. Relate the importance of meiosis to sexual reproduction and the maintenance of chromosome number.
- h. Identify and distinguish among forms of asexual and sexual reproduction.

B4. Investigate the transfer of energy from the sun to living systems.

- a. Describe the structure of ATP and its importance in life processes.
- b. Examine, compare, and contrast the basic processes of photosynthesis and cellular respiration.
- c. Compare and contrast aerobic and anaerobic respiration.

B5. Investigate the principles, mechanisms, and methodology of classical and molecular genetics.

- a. Compare and contrast the molecular structures of DNA and RNA as they relate to replication, transcription, and translation.
- b. Identify and illustrate how changes in DNA cause mutations and evaluate the significance of these changes.
- c. Analyze the applications of DNA technology (forensics, medicine, agriculture).
- d. Discuss the significant contributions of well-known scientists to the historical progression of classical and molecular genetics.
- e. Apply genetic principles to solve simple inheritance problems including monohybrid crosses, sex linkage, multiple alleles, incomplete dominance, and codominance.
- f. Examine inheritance patterns using current technology (gel electrophoresis, pedigrees, karyotypes).

B6. Investigate concepts of natural selection as they relate to diversity of life.

- a. Analyze how organisms are classified into a hierarchy of groups and subgroups based on similarities and differences.
- b. Identify characteristics of kingdoms including monerans, protists, fungi, plants and animals.
- c. Differentiate among major divisions of the plant and animal kingdoms (vascular/non-vascular; vertebrate/invertebrate).
- d. Compare the structures and functions of viruses and bacteria relating their impact on other living organisms.
- e. Identify evidence of change in species using fossils, DNA sequences, anatomical and physiological similarities, and embryology.
- f. Analyze the results of natural selection in speciation, diversity, adaptation, behavior and extinction.

B7. Investigate the interdependence and interactions that occur within an ecosystem.

- a. Analyze the flow of energy and matter through various cycles including carbon, oxygen, nitrogen and water cycles.
- b. Interpret interactions among organisms in an ecosystem (producer/consumer/decomposer, predator/prey, symbiotic relationships and competitive relationships).

- c. Compare variations, tolerances, and adaptations of plants and animals in major biomes.
- d. Investigate and explain the transfer of energy in an ecosystem including food chains, food webs, and food pyramids.
- e. Examine long and short-term changes to the environment as a result of natural events and human actions.

ENGLISH II

Competencies and Suggested Objective(s)

E1. Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.

- a. Produce individual and/or group compositions and/or projects to persuade, tell a story, describe, create an effect, explain or justify an action or event, inform, entertain, etc.
- b. Produce writing typically used in the workplace such as social, business, and technical correspondence; explanation of procedures; status reports; research findings; narratives for graphs; justification of decisions, actions, or expenses; etc.
- c. Write a response, reaction, interpretation, analysis, summary, etc., of literature, other reading matter, or orally presented material.
- d. Revise to ensure effective introductions, details, wording, topic sentences, and conclusions.

E2. Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.

- a. Listen to determine the main idea and supporting details, to distinguish fact from opinion, and to determine a speaker's purpose or bias.
- b. Speak with appropriate intonation, articulation, gestures, and facial expression.
- c. Speak effectively to explain and justify ideas to peers, to inform, to summarize, to persuade, to entertain, to describe, etc.

E3. Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.

- a. Read, view, and listen to distinguish fact from opinions and to recognize persuasive and manipulative techniques.
- b. Access both print and non-print sources to produce an I-Search paper, research paper, or project.
- c. Use computers and audio-visual technology to access and organize information for purposes such as resumes, career search projects, and analytical writings, etc.
- d. Use reference sources, indices, electronic card catalog, and appropriate research procedures to gather and synthesize information.

- E4. Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.**
- a. Interact with peers to examine real world and literary issues and ideas.
 - b. Show growth in critical thinking, leadership skills, consensus building, and self-confidence by assuming a role in a group, negotiating compromise, and reflecting on individual or group work.
- E5. Complete oral and written presentations which exhibit interaction and consensus within a group.**
- a. Share, critique, and evaluate works in progress and completed works through a process approach.
 - b. Communicate effectively in a group to present completed projects and/or compositions.
 - c. Edit oral and written presentations to reflect correct grammar, usage, and mechanics.
- E6. Explore cultural contributions to the history of the English language and its literature.**
- a. Explore a variety of works from various historical periods, geographical locations, and cultures, recognizing their influence on language and literature.
 - b. Identify instances of dialectal differences which create stereotypes, perceptions, and identities.
 - c. Recognize root words, prefixes, suffixes, and cognates.
 - d. Relate how vocabulary and spelling have changed over time.
- E7. Discover the power and effect of language by reading and listening to selections from various literary genres.**
- a. Listen to and read aloud selected works to recognize and respond to the rhythm and power of language to convey a message.
 - b. Read aloud with fluency and expression.
 - c. Analyze the stylistic devices, such as alliteration, assonance, word order, rhyme, onomatopoeia, etc., that make a passage achieve a certain effect.
 - d. Demonstrate how the use of language can confuse or inform, repel or persuade, or inspire or enrage.
 - e. Analyze how grammatical structure or style helps to create a certain effect.

E8. Read, discuss, analyze, and evaluate literature from various genres and other written material.

- a. Read and explore increasingly complete works, both classic and contemporary, for oral discussion and written analysis.
- b. Read, discuss, and interpret literature to make connections to life.
- c. Read from a variety of genres to understand how the literary elements contribute to the overall quality of the work.
- d. Identify qualities in increasingly complex literature that have produced a lasting impact on society.
- e. Read for enjoyment, appreciation, and comprehension of plot, style, vocabulary, etc.

E9. Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.

- a. Infuse the study of grammar and vocabulary into written and oral communication.
- b. Demonstrate, in the context of their own writing, proficient use of the conventions of standard English, including, but not limited to, the following: complete sentences, subject-verb agreement, plurals, spellings, homophones, possessives, verb forms, punctuation, capitalization, pronouns, pronoun-antecedent agreement, parallel structure, and dangling and misplaced modifiers.
- c. Give oral presentations to reinforce the use of standard English.
- d. Employ increasingly proficient editing skills to identify and solve problems in grammar, usage, and structure.

E10. Use language and critical thinking strategies to serve as tools for learning.

- a. Use language to facilitate continuous learning, to record observations, to clarify thought, to synthesize information, and to analyze and evaluate language.
- b. Interpret visual material orally and in writing.

U. S. HISTORY FROM 1877

Competencies and Suggested Objective(s)

H1. Explain how geography, economics, and politics have influenced the historical development of the United States in the global community.

- a. Apply economic concepts and reasoning when evaluating historical and contemporary social developments and issues (e.g., gold standard, free coinage of silver, tariff issue, laissez faire, deficit spending, etc.).
- b. Explain the emergence of modern America from a domestic perspective (e.g., frontier experience, Industrial Revolution and organized labor, reform movements of Populism and Progressivism, Women's Movement, Civil Rights Movement, the New Deal, etc.).
- c. Explain the changing role of the United States in world affairs since 1877 through wars, conflicts, and foreign policy (e.g., Spanish-American War, Korean conflict, containment policy, etc.).
- d. Trace the expansion of the United States and its acquisition of territory from 1877 (e.g., expansionism and imperialism).

H2. Describe the impact of science and technology on the historical development of the United States in the global community.

- a. Analyze the impact of inventions on the United States (e.g., telephone, light bulb, etc.).
- b. Examine the continuing impact of the Industrial Revolution on the development of our nation (e.g., mass production, computer operations, etc.).
- c. Describe the effects of transportation and communication advances since 1877.

H3. Describe the relationship of people, places, and environments through time.

- a. Analyze human migration patterns since 1877 (e.g., rural to urban, the Great Migration, etc.).
- b. Analyze how changing human, physical, geographic characteristics can alter a regional landscape (e.g., urbanization, Dust Bowl, etc.).

H4. Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

- a. Interpret special purpose maps, primary/secondary sources, and political cartoons.
- b. Analyze technological information on graphs, charts, and timelines.

- c. Locate areas of international conflict (e.g., Caribbean, Southeast Asia, Europe, etc.).

H5. Analyze the contributions of Americans to the ongoing democratic process to include civic responsibilities.

- a. Examine various reform movements (e.g., Civil Rights, Women's Movement, etc.).
- b. Examine the government's role in various movements (e.g., arbitration, 26th Amendment, etc.).
- c. Examine the role of government in the preservation of citizens' rights (e.g., 19th Amendment, Civil Rights Act of 1964).
- d. Examine individuals' duties and responsibilities in a democratic society (e.g., voting, volunteerism, etc.).

APPENDIX B:
WORKPLACE SKILLS

May 21, 2004

WORKPLACE SKILLS FOR THE 21ST CENTURY

- WP1 Allocates resources (time, money, materials and facilities, and human resources).
- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

May 21, 2004

APPENDIX C:
NATIONAL EDUCATIONAL TECHNOLOGY STANDARDS FOR STUDENTS

May 21, 2004

APPENDIX C
NATIONAL EDUCATIONAL TECHNOLOGY STANDARDS FOR STUDENTS

- T1 Basic operations and concepts
- Students demonstrate a sound understanding of the nature and operation of technology systems.
 - Students are proficient in the use of technology.
- T2 Social, ethical, and human issues
- Students understand the ethical, cultural, and societal issues related to technology.
 - Students practice responsible use of technology systems, information, and software.
 - Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.
- T3 Technology productivity tools
- Students use technology tools to enhance learning, increase productivity, and promote creativity.
 - Students use productivity tools to collaborate in constructing technology-enhanced models, prepare publications, and produce other creative works.
- T4 Technology communications tools
- Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.
 - Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.
- T5 Technology research tools
- Students use technology to locate, evaluate, and collect information from a variety of sources.
 - Students use technology tools to process data and report results.
 - Students evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.
- T6 Technology problem-solving and decision-making tools
- Students use technology resources for solving problems and making informed decisions.
 - Students employ technology in the development of strategies for solving problems in the real world.

May 21, 2004

APPENDIX D:
STANDARDS FOR ELECTRICIAN TAKEN FROM NATIONAL CENTER FOR
CONSTRUCTION EDUCATION AND RESEARCH

May 21, 2004

APPENDIX D

STANDARDS FOR ELECTRICIAN TAKEN FROM NATIONAL CENTER FOR CONSTRUCTION EDUCATION AND RESEARCH

ELT1.1	Electrical Safety
ELT1.2	Hand Bending
ELT1.3	Fasteners and Anchors
ELT1.4	Electrical Theory One
ELT1.5	Electrical Theory Two
ELT1.6	Electrical Test Equipment
ELT1.7	Introduction to the National Electrical Code®
ELT1.8	Raceways, Boxes, & Fittings
ELT1.9	Conductors
ELT1.10	Introduction to Electrical Blueprints
ELT1.11	Wiring: Commercial and Industrial
ELT1.12	Wiring Residential

May 21, 2004

APPENDIX E:
STUDENT COMPETENCY PROFILE

May 21, 2004

STUDENT COMPETENCY PROFILE
FOR
ELECTRICIAN I

Student: _____

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 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.

Identify terms and symbols commonly used on blueprints used in electrical trades.

Unit 1: Orientation/Leadership and Personal Development

- _____ 1. Describe local program and vocational center policies and procedures.
- _____ 2. Describe employment opportunities and responsibilities for electricians and related employees.
- _____ 3. State procedures of leadership used to reach an agreement in an orderly manner and personal development opportunities provided students in electricity trades by SkillsUSA.

Unit 2: Basic Safety

- _____ 1. Describe general safety rules for working in a shop/lab and industry.
- _____ 2. Identify and apply safety around welding operations.
- _____ 3. Identify and explain use of various barriers and confinements.
- _____ 4. Recognize safe lifting and the use of ladders and scaffolds.
- _____ 5. Explain the Material Safety Data Sheets (MSDS).
- _____ 6. Explain fires.
- _____ 7. Explain safety in and around electrical situations.

Unit 3: Basic Math

- _____ 1. Apply basic math skills.

Unit 4: Hand and Power Tools

- _____ 1. Identify various hand and power tools used in electrical trades.
- _____ 2. Explain the safe use of common hand and power tools used in electrical trades.
- _____ 3. Explain the procedures for the maintenance of power tools.

Unit 5: Direct Current (DC) Circuits

- _____ 1. Describe the terms and scientific principles associated with direct current electricity.
- _____ 2. Create circuits and measure DC electricity using the multimeter.
- _____ 3. Describe the principles of magnetism and electromagnetic properties.

Unit 6: Alternating Current (AC) Circuits

- _____ 1. Describe the terms and scientific principles associated with alternating current electricity.
- _____ 2. Describe and construct series and parallel circuits.

Unit 7: Introduction to Residential Wiring

- _____ 1. Identify various residential electrical circuits.
- _____ 2. Wire various residential electrical circuits.

Unit 8: Basic Rigging

- _____ 1. Explain and identify safe rigging and equipment.
- _____ 2. Identify and explain the use of derricks and cranes.

Unit 9: Introduction to Blueprints

- _____ 1. Identify terms and symbols commonly used on blueprints used in electrical trades.
- _____ 2. Relate information on prints to real parts and locations.
- _____ 3. Identify and apply basic principles of blueprints.

STUDENT COMPETENCY PROFILE
FOR
ELECTRICIAN II

Student: _____

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 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: Basic Safety (Review)

- _____ 1. Review general safety rules for working in a shop/lab and industry.
- _____ 2. Review and apply safety around welding operations.
- _____ 3. Review and explain use of various barriers and confinements.
- _____ 4. Review safe lifting and the use of ladders and scaffolds.
- _____ 5. Review the Material Safety Data Sheets (MSDS).
- _____ 6. Review fires.
- _____ 7. Review safety in and around electrical situations.

Unit 2: AC Circuits for Residential Wiring

- _____ 1. Determine the type and size of conductors/cables used in the electrical trades.
- _____ 2. Determine wiring connections utilizing switching circuits to NEC and local codes.
- _____ 3. Determine grounding requirements according to NEC and local codes.

Unit 3: Load Centers and Overcurrent Protection

- _____ 1. Determine the types of overcurrent protection devices including fuses, circuit breakers, arc fault interrupters, and ground fault circuit interrupters (GFCI) used in safety switches or load centers.
- _____ 2. Determine placement of overcurrent protection devices.

Unit 4: Rough-In

- _____ 1. Determine locations of electrical outlets as shown on the electrical blueprint, according to the NEC.
- _____ 2. Wire electrical devices/loads in accordance with NEC and electrical floor plan.

Unit 5: Residential Service

- _____ 1. Determine service entrance requirements as per NEC.
- _____ 2. Install the required service entrance as per NEC.

Unit 6: Trim-Out and Troubleshooting

- _____ 1. Determine the requirements for electrical trim-out.
- _____ 2. Troubleshoot a residence according to the National Electrical Code (NEC).

Unit 7: Motors and Controllers

- _____ 1. Demonstrate safe procedures associated with electrical motors in new and existing systems.
- _____ 2. Differentiate between types/classes of electrical motors.
- _____ 3. Determine speed, direction, and control of AC single- and three-phase and DC motors.
- _____ 4. Identify the physical and electrical characteristics of electrical motors.
- _____ 5. Identify the physical and electrical characteristics of electrical starters.
- _____ 6. Wire single/three-phase electrical motors using manual and automatic controllers/starters with forward/reverse modes.

Unit 8: Introduction to Programmable Logic Controllers (PLC)

- _____ 1. Describe function of programmable logic controls (PLC).
- _____ 2. Describe application of programmable logic controls.

Unit 9: Commercial and Industrial Wiring

- _____ 1. Demonstrate hand bending procedures.
- _____ 2. Identify and install fasteners and anchors.
- _____ 3. Identify and install various raceways, boxes, and fittings.
- _____ 4. Explain, identify, and perform various functions of commercial and industrial wiring.