

# Electricity I

**8533 36 weeks / 140 hours**

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The components of this instructional framework were developed by the following technical panel and curriculum development team members:

Pete Aheron, Project Manager, Varney Incorporated  
Russell Brooks, Apprenticeship Committee Chairman, Central Virginia Electrical Contractors Association  
Richard Champigny III, Electricity Instructor, Chesterfield County Public Schools  
Nathan Dowdy, Talent and Man Power Manager, Moore’s Electrical and Mechanical Construction Incorporated  
Gary Duff, Assistant Director, Richmond Electricians’ Joint Apprenticeship Training Committee  
Gary Fitzgerald Jr., Electricity Instructor, Franklin County High School

Gene Klotz, President, Summit Electrical Services  
Harry McGuire Jr., Electricity Instructor, Valley Career and Technical Center  
Michael Payne, Electricity Instructor, Powhatan County Schools  
James Pollard Jr., Electricity Instructor, Pittsylvania Career and Technical Center  
Gregg Spicer, Assistant Training Director, Richmond Electricians' Joint Apprentice Training Committee  
Dagan Stephens, Electricity Instructor, Shenandoah County Schools  
Lee Trent, Plant Manager, Future Tek Incorporated

Correlations to the Virginia Standards of Learning were reviewed and completed by:

Vickie L. Inge, Mathematics Committee Member, Virginia Mathematics and Science Coalition  
Anne F. Markwith, New Teacher Mentor, Gloucester County Public Schools  
Cathy Nichols-Cocke, PhD, Fairfax High School, Fairfax County Public Schools  
Caroline C. Wheeler, M.T., Secondary English

The framework was edited and produced by the CTE Resource Center:

Robin A. Jedlicka, Writer, Editor  
Kevin P. Reilly, Administrative Coordinator

J. Anthony Williams, Specialist, Trade and Industrial Education and Related Clusters  
Office of Career, Technical, and Adult Education  
Virginia Department of Education

Dr. Tricia S. Jacobs, CTE Coordinator of Curriculum and Instruction  
Office of Career, Technical, and Adult Education Services  
Virginia Department of Education

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## Course Description

**Suggested Grade Level:** 10 or 11

Students develop fundamental electrical skills to help them prepare for a career in the installation, operation, maintenance, and repair of residential, commercial, and industrial systems. Students will engage in hands-on activities in a lab setting. They will be introduced to residential wiring of houses and apartments; commercial wiring of retailers, schools, businesses, and hospitals; and industrial wiring of factories.

*As noted in [Superintendent's Memo #058-17 \(2-28-2017\)](#), this Career and Technical Education (CTE) course must maintain a maximum pupil-to-teacher ratio of 20 students to one teacher, due to safety regulations. The 2016-2018 biennial budget waiver of the teacher-to-pupil ratio staffing requirement does not apply.*

# Task Essentials List

- Tasks/competencies designated by plus icons (⊕) in the left-hand column(s) are essential
- Tasks/competencies designated by empty-circle icons (○) are optional
- Tasks/competencies designated by minus icons (⊖) are omitted
- Tasks marked with an asterisk (\*) are sensitive.

Task Number	8533	Tasks/Competencies
Applying Basic Construction Safety Standards (Core Safety)		
39	⊕	Comply with federal, state, and local safety legal requirements.
40	⊕	Maintain a safe working environment.
41	⊕	Explain safe working practices around electrical hazards.
42	⊕	Identify emergency first aid procedures.
43	⊕	Identify the types of fires and the methods used to extinguish them.
44	⊕	Identify personal protective equipment (PPE) requirements.
45	⊕	Inspect course-specific hand and power tools to visually identify defects.
46	⊕	Demonstrate lifting and carrying techniques.
47	⊕	Demonstrate safe laddering techniques.
48	○	Demonstrate safe scaffolding techniques.
49	⊕	Demonstrate lockout/tagout procedures.
50	⊕	Report injuries.
51	⊕	Report personal, environmental, and equipment safety violations to the appropriate authority.
52	⊕	Earn the OSHA 10 card.
53	⊕	Pass safety exam.
Focusing on the Electrician's Profession		
54	⊕	Explain electrician-specific safety issues.
55	⊕	Discuss current topics in the industry.
56	⊕	Explore the various occupations available in electricity and related fields.
57	⊕	Investigate career opportunities in the electrical industry.
58	⊕	Discuss all postsecondary training and licensing in the electricity field.
59	⊕	Describe the employee's role in ensuring the success of the electrical business.
60	⊕	Identify national and local trade organizations.
Using Tools and Materials		
61	⊕	Utilize the various types of hand tools used by electricians.
62	⊕	Utilize the various types of power tools used by electricians.
63	⊕	Identify commonly used materials by name and by regional variance of terminology.
64	⊕	Prepare a material inventory.
Applying Basic Electrical Theory		
65	⊕	Explain basic electrical theory.
66	⊕	Explain the relationship of electron theory to circuit design by the use of Ohm's Law.
67	⊕	Use a variety of meters to take readings.
68	⊕	Calculate series circuits.
69	⊕	Wire a series circuit.
70	⊕	Calculate parallel circuits.
71	⊕	Wire parallel circuits.

Task Number	8533	Tasks/Competencies
Solving Mathematical Problems Related to the Electrical Field		
72	+	Solve word problems involving whole numbers, fractions, and decimals.
73	+	Solve algebraic formulas pertaining to electrical applications.
74	+	Solve problems involving percentage, ratio, and proportion.
75	+	Measure distances using scales and measuring devices.
Interpreting Prints and Specifications		
76	+	Draw electrical circuits.
77	+	Read electrical construction drawings and specifications.
Navigating the NEC Book		
78	+	Explain the intent of the NEC.
79	+	Interpret the NEC requirements for electrical installation.
Selecting and Installing Conductors		
80	+	Identify various types of conductors and their associated applications.
81	+	Install conductors.
82	+	Terminate conductors with lugs, connectors, or terminals.
Identifying Panelboards and Switchboards		
83	+	Identify purpose and location of overcurrent protective devices (OCPDs) and service entrance equipment.
Describing Generators and Power Supplies		
84	+	Explain principles of generating electricity.
85	+	Explain principles of magnetism/electromagnetism.
86	+	Apply principles of generating electricity.
87	+	Identify components of a typical stand-alone generator.
Exploring Environmentally Friendly Choices		
88	+	Identify energy-efficient equipment and methods.
89	○	Explore the environmental impacts of land use and site location for a proposed building project.
90	○	Explore design choices for a proposed building project that reflect conservation and efficient use of materials.
91	○	Explore design choices for a proposed building project that reflect conservation and efficient use of energy.
92	○	Explore design choices for a proposed building project that reflect conservation and efficient use of water.
93	○	Explore design choices that can affect indoor air quality for proposed building projects.

Legend: + Essential ○ Non-essential - Omitted

## Curriculum Framework

# **Applying Basic Construction Safety Standards (Core Safety)**

## **Task Number 39**

**Comply with federal, state, and local safety legal requirements.**

### **Definition**

Compliance should include the identification of the Hazard Communication Standard (HazCom), the information included on safety data sheets (SDS), and the responsibilities of employers and employees under HazCom.

Compliance should also include the Occupational Safety and Health Administration (OSHA), the Virginia Occupational Safety and Health Compliance Program (VOSH), and the Environmental Protection Agency (EPA).

### **Process/Skill Questions**

- Where should hazardous materials be stored?
- What information can be found on an SDS?

## **NCCER Core Curriculum: Introductory Craft Skills, 2009**

**00101-09 Basic Safety**

**00106-09 Basic Rigging**

## **Task Number 40**

**Maintain a safe working environment.**

### **Definition**

Maintenance should be ongoing and should include regular inspection of the working environment. Maintenance should result in identifying potential hazards on a job site or in the lab, such as unstable or improperly erected scaffolding, electrical hazards, job site debris, improperly stored materials, and air quality hazards and when present, must be remedied by appropriate measures and comply with school and instructor's guidelines.

### **Process/Skill Questions**

- What are some examples of job site hazards?
- Why is it important to use good housekeeping standards on a job site?

- Why is it important to store materials and tools in their proper places?

## **NCCER Core Curriculum: Introductory Craft Skills, 2009**

### **00101-09 Basic Safety**

## **Task Number 41**

### **Explain safe working practices around electrical hazards.**

#### **Definition**

Explanation should include

- identifying equipment used to test electrical circuits
- describing safe working conditions
- demonstrating safe work habits according to industry standards and instructor's guidelines.

#### **Process/Skill Questions**

- What is the definition of *proximity work*?
- What are safe working clearances according to the National Electric Code (NEC)?
- What are considered safe working conditions and safe working habits?
- What is the unseen hazard with electrical work?

## **NCCER Core Curriculum: Introductory Craft Skills, 2009**

### **00101-09 Basic Safety**

## **Task Number 42**

### **Identify emergency first aid procedures.**

#### **Definition**

Identification should include first aid procedures for accidents involving

- bodily fluids
- electrical injuries
- eye injuries
- falls
- burns

according to standard first aid and school policies.

## **Process/Skill Questions**

- What are the steps that should be followed in the event of an accident?
- Why is knowing cardiopulmonary resuscitation (CPR) an important skill within the electrical trades?
- Why is it important to be certified to administer first aid?
- What are the different classifications (degrees) of electrical burns?

## **NCCER Core Curriculum: Introductory Craft Skills, 2009**

### **00101-09 Basic Safety**

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## **Task Number 43**

### **Identify the types of fires and the methods used to extinguish them.**

#### **Definition**

Identification should include the classifications of fires (A, B, C, D, K), causes and prevention of fires, types of extinguishers, and, when possible, the demonstrated use of a fire extinguisher, in accordance with government regulations and instructor's guidelines.

#### **Process/Skill Questions**

- Why do fires have different classifications, and what are they?
- What is the fire triangle?
- What are the three things necessary to start a fire?
- Why is it important to know the classification of fire when trying to extinguish it?
- Why should extinguishers be inspected, and how often should they be inspected?
- What are the classifications of extinguishers?

## **NCCER Core Curriculum: Introductory Craft Skills, 2009**

### **00101-09 Basic Safety**

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## **Task Number 44**

### **Identify personal protective equipment (PPE) requirements.**

#### **Definition**

Identification should include procedures for properly putting on, wearing, and removing PPE and inspecting PPE to determine if it is safe to use. (Appropriate PPE may include eye protection, respirator, hard hat, gloves, safety harness, hearing protection, and safety shoes.)

## **Process/Skill Questions**

- What are some dangerous effects of sun exposure, and how can one significantly prevent these effects?
- Why is wearing jewelry prohibited while in the lab or on the job site?

## **NCCER Core Curriculum: Introductory Craft Skills, 2009**

### **00101-09 Basic Safety**

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## **Task Number 45**

### **Inspect course-specific hand and power tools to visually identify defects.**

#### **Definition**

Inspection of power tools should include

- identifying components of machinery (e.g., guards, blades, moving parts, start/stop switches)
- identifying standard safety procedures (i.e., lab practices and manufacturer's recommendations)
- observing a demonstration of the safe operation and use of each piece of machinery in lab
- identifying tool defects.

## **Process/Skill Questions**

- What are some of the basic power tools used in construction?
- What are the proper actions to take before using a power circular saw?
- Why should a power tool always be grounded?

## **NCCER Core Curriculum: Introductory Craft Skills, 2009**

### **00101-09 Basic Safety**

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## **Task Number 46**

### **Demonstrate lifting and carrying techniques.**

#### **Definition**

Demonstration involves lifting and carrying materials and equipment based on the principles of

- lifting with legs



- keeping back straight
- holding load close to the body
- getting help, if necessary

in accordance with government regulations and instructor's guidelines.

### **Process/Skill Questions**

- What are common injuries associated with improper lifting techniques?
- What can one do to prevent injury?
- How does proper positioning affect proper technique?

## **NCCER Core Curriculum: Introductory Craft Skills, 2009**

### **00101-09 Basic Safety**

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## **Task Number 47**

### **Demonstrate safe laddering techniques.**

#### **Definition**

Demonstration should involve using appropriate conduct and safety procedures while using aluminum ladders (e.g., 3-point contact), while carrying ladders (e.g., two people at all times) and erecting and setting ladders. Identification of additional ladder types may include

- wall (straight) ladder
- extension ladder
- roof ladder
- attic ladder
- special purpose ladders (e.g., "A" ladder, folding ladder, pompier ladder)
- solid beam ladder
- truss beam wood ladder
- aluminum ladder
- wood and aluminum truss ladder
- fiberglass ladder

and the parts and safety features of each.

### **Process/Skill Questions**

- Why are ladders rated for certain weights?
- Why is the apex (highest point) of a step ladder not considered a step?

## **NCCER Core Curriculum: Introductory Craft Skills, 2009**

## **Task Number 48**

### **Demonstrate safe scaffolding techniques.**

#### **Definition**

Demonstration should include inspecting settings, duty ratings, and safety tags.

#### **Process/Skill Questions**

- How can one determine the safe weight limit of any particular scaffolding?
- In what situations is scaffolding preferred or required?

### **NCCER Core Curriculum: Introductory Craft Skills, 2009**

## **Task Number 49**

### **Demonstrate lockout/tagout procedures.**

#### **Definition**

Demonstration should include the identification of different types of lockout/tagout equipment and an explanation of proper lockout/tagout procedures, in accordance with industry standards and the instructor's guidelines.

#### **Process/Skill Questions**

- Who is authorized to remove a lockout and tagout?
- Why should equipment be locked out/tagged out?
- Who is required to use a lockout/tagout?
- How many keys are issued for a lockout/tagout?

### **NCCER Electrical Standards, 2011**

## **Task Number 50**

### **Report injuries.**

#### **Definition**

Report should consist of an immediate oral statement of the job-related or non-job-related injury to the instructor or supervisor, and may be followed by a written confirmation reporting date, extent of injury, and circumstances of the accident.

#### **Process/Skill Questions**

- Why is it important to report injuries?
- What are common reporting procedures?
- Why is it important to report an injury promptly, before leaving the job site?
- What is workers' compensation?
- What are the key components of a report?

#### **NCCER Core Curriculum: Introductory Craft Skills, 2009**

##### **00101-09 Basic Safety**

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## **Task Number 51**

### **Report personal, environmental, and equipment safety violations to the appropriate authority.**

#### **Definition**

Report should include an oral or written statement identifying the violation and the date it was observed and should be given to the instructor, supervisor, or local OSHA inspector(s).

#### **Process/Skill Questions**

- What ethical considerations might be involved when reporting coworkers?
- Why is it important to follow reporting procedures?
- What is *liability*?

#### **NCCER Core Curriculum: Introductory Craft Skills, 2009**

##### **00101-09 Basic Safety**

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## **Task Number 52**

### **Earn the OSHA 10 card.**

#### **Definition**

Earning an OSHA 10 card will

- recognize that one has acquired 10-hours of safety instruction
- help teach national standards for personal safety within a lab environment
- validate safety skills to the industry
- help workers become more safety conscious and responsible.

#### **Process/Skill Questions**

- What are the benefits of earning the OSHA 10 card?
- What is OSHA and how are its standards validated?
- Why was OSHA established and how has it evolved?

### **NCCER Core Curriculum: Introductory Craft Skills, 2009**

**00101-09 Basic Safety**

**00106-09 Basic Rigging**

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## **Task Number 53**

### **Pass safety exam.**

#### **Definition**

Passing the exam must demonstrate participation in safety training programs, including attending safety meetings and completing periodic demonstration of knowledge and skills gained from program topics (e.g., interpretation of SDS).

#### **Process/Skill Questions**

- How often should one participate in safety training programs? Why?
- How does insurance impact the requirement of continuous retraining for safety?
- What is *workers' compensation*?

### **NCCER Core Curriculum: Introductory Craft Skills, 2009**

**00101-09 Basic Safety**

# Focusing on the Electrician's Profession

## Task Number 54

**Explain electrician-specific safety issues.**

### Definition

Explanation should include

- reasons why safety is important
- key factors involved with safe work practice
- types and effects of legal and illegal drugs on worker productivity and safety

in accordance with industry standards and instructor guidelines.

### Process/Skill Questions

- What happens to those who do not adhere to safe working practices?
- What are the effects of insurance?
- How do drugs affect job performance?
- How does safety affect deadlines and on-job scheduling?
- How does reckless behavior affect your life beyond the job?

**NCCER Core Curriculum: Introductory Craft Skills, 2009**

**00101-09 Basic Safety**

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## Task Number 55

**Discuss current topics in the industry.**

### Definition

Discussion should include

- identifying and analyzing trade-related materials
- updating new technologies
- naming resources that address local economy issues (regional job opportunities).

### Process/Skill Questions

- What caused the Northeast blackout of 2003?

- Why is the Nuclear Engineering Education Research (NEER) Program creating certifications for new nuclear construction?
  - What impact does government regulation or deregulation have on the power distribution industry?
- 

## **Task Number 56**

### **Explore the various occupations available in electricity and related fields.**

#### **Definition**

Exploration should include apprenticeships for various occupations, including

- construction electrician (residential, commercial)
- industrial electrician
- lineman
- security systems
- heating, ventilation, air conditioning, and refrigeration (HVACR)
- and service (troubleshooting).

#### **Process/Skill Questions**

- Why are apprenticeships important?
- What type of work does a service electrician do?
- What types of entry-level careers are there for electricians in energy generation and energy transmission?
- What training is required before earning a journeyman's card?

#### **NCCER Electrical Standards, 2011**

##### **26101-11 Orientation to the Electrical Trade**

#### **Suggested Resources for Topics in Energy**

##### **Exploring Careers in the Field of Energy**

[The Bureau of Labor Statistics provides students with occupational outlook data for a variety of careers in energy-related fields.](#)

##### **Exploring Pathways to Six Key Energy Careers**

[The Get Into Energy Career Pathways Roadmap provides detailed information for teachers and students about educational requirements, credentials, and career opportunities in six key energy professions.](#)

##### **Planning an Education and Career in Energy**

[Students can research information about duties, educational requirements, and certifications in 17 disciplines related to energy.](#)

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## Task Number 57

### Investigate career opportunities in the electrical industry.

#### Definition

Investigation should illustrate

- career pathways based on current course
- alternative career pathways (e.g., management, education, power plant operations and energy transmission, building trades, sales, maintenance, and HVACR) based on similar skill sets.

#### Process/Skill Questions

- Why is it important to communicate directly with people in the field?
- Why is there a shortage of electricians?
- What roles do electricians play in industries such as natural gas and non-nuclear energy generation?
- What are the educational pathways or training required for careers in the electricity/energy industry?
- What opportunities for advancement are there for energy industry workers?

### NCCER Electrical Standards, 2011

#### 26101-11 Orientation to the Electrical Trade

#### Suggested Resources for Topics in Energy

##### Exploring Careers in the Field of Energy

[The Bureau of Labor Statistics provides students with occupational outlook data for a variety of careers in energy-related fields.](#)

##### Exploring Pathways to Six Key Energy Careers

[The Get Into Energy Career Pathways Roadmap provides detailed information for teachers and students about educational requirements, credentials, and career opportunities in six key energy professions.](#)

##### Planning an Education and Career in Energy

[Students can research information about duties, educational requirements, and certifications in 17 disciplines related to energy.](#)

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## Task Number 58

### Discuss all postsecondary training and licensing in the electricity field.

#### Definition

Discussion should result in the identification of, and the differentiation between, the following educational opportunities:

- Registered apprenticeship program
- Two-year and four-year colleges
- Military training
- Adult learning centers
- Professional/private education agencies
- Cooperative education
- Work-based learning
- Workshops conducted by the Department of Professional and Occupational Regulations (DPOR).

### **Process/Skill Questions**

- How does one become a journeyman?
- What is an apprenticeship program?
- What is the difference between a journeyman license and a master license?

## **NCCER Electrical Standards, 2011**

### **26101-11 Orientation to the Electrical Trade**

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## **Task Number 59**

### **Describe the employee’s role in ensuring the success of the electrical business.**

#### **Definition**

Description should include how Workplace Readiness Skills and employees’ actions and behavior impact the construction/electrical business’ success.

### **Process/Skill Questions**

- How does an employee’s work ethic and integrity impact the company and the industry in general?
- What is the role of reading and writing in the workplace?
- What are examples of “theft of time”?
- What is the value of teamwork on a work site?

## **NCCER Electrical Standards, 2011**

### **26101-11 Orientation to the Electrical Trade**

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## **Task Number 60**



# Identify national and local trade organizations.

## Definition

Identification should include

- SkillsUSA (how to become a member and participate as a team member)
- unions and local apprenticeships.

## Process/Skill Questions

- What are the meanings of the following acronyms:
  - - NCCER
    - NOCTI
    - IBEW
    - IBC
- What are the benefits of membership in the student and trade organizations?
- What are the objectives of apprenticeship programs?

## NCCER Electrical Standards, 2011

### 26101-11 Orientation to the Electrical Trade

# Using Tools and Materials

## Task Number 61

# Utilize the various types of hand tools used by electricians.

## Definition

Utilization should include

- naming the various types of hand tools
- stating their correct usage
- citing the maintenance associated with each tool
- safely using tools in accordance with the manufacturer's instructions, government regulations, and instructor's guidelines.

## Process/Skill Questions

- Why is hand tool safety important?
- What is considered improper use of hand tools?
- Why should workers properly care for and maintain hand tools?

- How does the condition and maintenance of hand tools affect safety?

## **NCCER Core Curriculum: Introductory Craft Skills, 2009**

### **00103-09 Introduction to Hand Tools**

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## **Task Number 62**

### **Utilize the various types of power tools used by electricians.**

#### **Definition**

Utilization should include

- naming the various types of power tools
- stating their correct usage
- citing the maintenance associated with each tool
- safely using these tools in accordance with the manufacturer's instructions, government regulations, and instructor's guidelines.

#### **Process/Skill Questions**

- Why should you inspect every power tool prior to using it?
- What is the difference between a double-insulated drill and a grounded power tool?
- Why is it important to know operating instructions prior to use of a power tool?

## **NCCER Core Curriculum: Introductory Craft Skills, 2009**

### **00104-09 Introduction to Power Tools**

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## **Task Number 63**

### **Identify commonly used materials by name and by regional variance of terminology.**

#### **Definition**

Identification should consist of naming electrical materials and supplies associated with different wiring systems, including nonmetallic (NM) sheathed cabling, conduit, raceways, and others as specified by the instructor.

#### **Process/Skill Questions**

- What is a Madison strap, or standoff strap?
- What is a one-hole strap? What is a two-hole strap?
- What is electrical metallic tubing (EMT), rigid metal conduit (RMC), and intermediate metal conduit (IMC)?
- What is a 1900, or a four-by-four-by-one-and-a-half box?
- What is an 8-B box, or octagon box?

## **NCCER Electrical Standards, 2011**

### **26108-11 Raceways and Fittings**

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## **Task Number 64**

### **Prepare a material inventory.**

#### **Definition**

Preparation must include a complete and accurate inventory and supply list of available electrical materials in accordance with instructor's guidelines.

#### **Process/Skill Questions**

- Why is inventory important?
- What is the purpose of a material inventory? What is its role in the business' success?
- How does inventory affect productivity?
- How does inventory use Roman numerals (quantities and lengths of supplies: C, D, M)?

## **Applying Basic Electrical Theory**

### **Task Number 65**

### **Explain basic electrical theory.**

#### **Definition**

Explanation should include identification and definitions of the parts of an atom as applied to electron flow, in accordance with instructor's guidelines.

#### **Process/Skill Questions**

- What is  $E$ ?
- What is  $P$ ?
- What is  $I$  and what is  $R$ ?
- What is *volt/ampere*?

## **NCCER Electrical Standards, 2011**

### **26103-11 Introduction to Electrical Circuits**

### **26104-11 Electrical Theory**

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## **Task Number 66**

### **Explain the relationship of electron theory to circuit design by the use of Ohm's Law.**

#### **Definition**

Explanation should involve solving and explaining relationships between unknown parameters for voltage, current, and resistance in an electrical circuit, in accordance with instructor's guidelines.

#### **Process/Skill Questions**

- What is so important about understanding electron theory?
- What is an *amp*?
- What is required to produce an amp?
- In which academic discipline is the electron theory studied?

## **NCCER Electrical Standards, 2011**

### **26103-11 Introduction to Electrical Circuits**

### **26104-11 Electrical Theory**

## **Task Number 67**

### **Use a variety of meters to take readings.**

#### **Definition**

Utilization should include a meter that is selected, set, and adjusted properly for a specified test or measurement (voltage, amperage, resistance, and continuity). Scales must be read correctly on digital and analog meters.

#### **Process/Skill Questions**

- What are the common types of meters used in the electricity trade? What do they measure?
- Why is it important to have the meter set to the proper function before taking a reading?

- Why should the meter leads be inspected before taking a reading?
- How is a meter verified?

## **NCCER Electrical Standards, 2011**

### **26102-11 Electrical Safety**

### **26112-11 Electrical Test Equipment**

## **Task Number 68**

### **Calculate series circuits.**

#### **Definition**

Calculation should include identifying relationships and solving unknown values for voltage, current, resistance, and wattage for series circuits, using Ohm's Law, in accordance with instructor's guidelines.

## **NCCER Electrical Standards, 2011**

### **26103-11 Introduction to Electrical Circuits**

### **26104-11 Electrical Theory**

## **Task Number 69**

### **Wire a series circuit.**

#### **Definition**

Wiring should include the fabrication of a series circuit using lab materials. Circuit must conform to common trade practices and instructor's guidelines.

#### **Process/Skill Questions**

- What is an example of a series circuit?
- What happens when a series circuit is opened?
- Why are three light bulbs dimmed in a series circuit?

## **NCCER Electrical Standards, 2011**

### **26103-11 Introduction to Electrical Circuits**

## Task Number 70

### Calculate parallel circuits.

#### Definition

Calculation should include identifying relationships and solving unknown values for voltage, current, resistance, and wattage for parallel circuits, using Ohm's Law, in accordance with instructor's guidelines.

#### NCCER Electrical Standards, 2011

26103-11 Introduction to Electrical Circuits

26104-11 Electrical Theory

## Task Number 71

### Wire parallel circuits.

#### Definition

Wiring should include the fabrication of a parallel circuit, using lab materials. Circuit must conform to common trade practices and instructor's guidelines.

#### Process/Skill Questions

- What is an electrical *pigtail*?
- What color wire is used in a parallel circuit?
- What is the minimum number of wires needed to complete a parallel circuit?

#### NCCER Electrical Standards, 2011

26103-11 Introduction to Electrical Circuits

26104-11 Electrical Theory

## Solving Mathematical Problems Related to the Electrical Field

## **Task Number 72**

### **Solve word problems involving whole numbers, fractions, and decimals.**

#### **Definition**

Solutions to word problems should use addition, subtraction, division, multiplication up to four digits, fractions, and decimals commonly used by electricians, in accordance with instructor's guidelines.

#### **Process/Skill Questions**

- Why is it important for electricians to be able to convert fractions to decimals?
- Why is it important for electricians to understand word problems?
- How are fractions typically used in electrical work?

#### **NCCER Core Curriculum: Introductory Craft Skills, 2009**

##### **00102-09 Introduction to Construction Math**

## **Task Number 73**

### **Solve algebraic formulas pertaining to electrical applications.**

#### **Definition**

Solutions to algebraic formulas should require that values be assigned on a grid and, using Ohm's Law, be solved for missing parameters, according to instructor guidelines.

#### **Process/Skill Questions**

- What is the equation of Ohm's Law?
- What is Watt's Law?
- What is Kirchoff's Law?

#### **NCCER Core Curriculum: Introductory Craft Skills, 2009**

##### **00102-09 Introduction to Construction Math**

## **Task Number 74**

## **Solve problems involving percentage, ratio, and proportion.**

### **Definition**

Solutions to problems should involve calculating percentage (e.g., conductor/box fill), and calculating ratio and proportion (e.g., transformer windings), according to instructor's guidelines.

### **Process/Skill Questions**

- What is the relationship between true power and apparent power?
- What is the ratio of a transformer with a 600 volt (V) primary and 120 V secondary?
- What percentage of a circuit can be used?

### **NCCER Core Curriculum: Introductory Craft Skills, 2009**

#### **00102-09 Introduction to Construction Math**

## **Task Number 75**

## **Measure distances using scales and measuring devices.**

### **Definition**

Measurement should include

- using various scales and drawing specified lines to length (e.g.,  $1/8" = 1'0"$ ,  $1/4" = 1'0"$ )
- using rule to measure distances assigned to the nearest  $1/16"$

in accordance with instructor guidelines.

### **Process/Skill Questions**

- In mathematical terms, what is "one quarter to a foot" and how is it expressed?
- How many scales are on an architect's scale?
- Why is understanding measuring devices important in electricity?

### **NCCER Core Curriculum: Introductory Craft Skills, 2009**

#### **00102-09 Introduction to Construction Math**

## **Interpreting Prints and Specifications**



## **Task Number 76**

### **Draw electrical circuits.**

#### **Definition**

Drawing should include switches, outlets, and wiring placed in their appropriate positions, using accepted drafting standard symbols and NEC minimum guidelines, as assigned by instructor.

#### **Process/Skill Questions**

- Why are symbols used?
- What is a schematic? How is it used?
- What is a one-line? How is it used?

#### **NCCER Electrical Standards, 2011**

**26103-11 Introduction to Electrical Circuits**

**26104-11 Electrical Theory**

**26110-11 Basic Electrical Construction Drawings**

## **Task Number 77**

### **Read electrical construction drawings and specifications.**

#### **Definition**

Reading should include components used in construction, as shown by drafting standards, and development of a list of materials from plans and specifications, in accordance with instructor's guidelines.

#### **Process/Skill Questions**

- What is a legend?
- What is a specification?
- Are blueprints always blue?
- Should the drawing have a scale?
- What does NTS (not to scale) mean?
- How is the scale interpreted?

#### **NCCER Electrical Standards, 2011**

**26104-11 Electrical Theory**

# Navigating the NEC Book

## Task Number 78

### Explain the intent of the NEC.

#### Definition

Explanation should include the purpose, scope, intent, enforcement, code arrangement, and history of the NEC.

#### Process/Skill Questions

- What is the *NEC*?
- Who uses the NEC?
- What is the purpose of the NEC?

#### NCCER Electrical Standards, 2011

26105-11 Introduction to the National Electrical Code

26111-11 Residential Electrical Services

## Task Number 79

### Interpret the NEC requirements for electrical installation.

#### Definition

Interpretation should involve the use of the NEC book (e.g., to locate definitions, to identify code markings) and use of NEC to calculate general job requirements, including residential, commercial, and industrial wiring methods.

#### Process/Skill Questions

- What is *Article 250*?
- Who enforces the NEC?
- Who designs and writes the code?
- What is an FPN?

#### NCCER Electrical Standards, 2011

26105-11 Introduction to the National Electrical Code

# Selecting and Installing Conductors

## Task Number 80

**Identify various types of conductors and their associated applications.**

### Definition

Identification should include types of conductors (determined by using manufacturer's markings, wire stripper, or American Wire Gauge [AWG]) and an application for each.

### Process/Skill Questions

- What is Romex cable?
- What is NM cable?
- Where is service entrance (SE) cable typically used?
- What does SE stand for?

### NCCER Electrical Standards, 2011

26109-11 Conductors and Cables

26111-11 Residential Electrical Services

## Task Number 81

**Install conductors.**

### Definition

Installation should include various wiring methods and industry-accepted testing procedures in accordance with NEC standards.

### Process/Skill Questions

- What is the abbreviated terminology for copper and aluminum?
- What is a *bending radius*?
- Why is it important to support a conductor properly?

### NCCER Electrical Standards, 2011

26108-11 Raceways and Fittings

**26109-11 Conductors and Cables**

**26111-11 Residential Electrical Services**

## **Task Number 82**

### **Terminate conductors with lugs, connectors, or terminals.**

#### **Definition**

Terminating conductors includes stripping conductors and installing lugs, connectors, or terminals in accordance with instructor's guidelines and manufacturer's specifications.

#### **Process/Skill Questions**

- What is a mechanical connector?
- What is a compression sleeve?
- What is the purpose of a wire nut?
- Why do we have different sized wire nuts?
- Which way should the wire and wire nut be twisted?

#### **NCCER Electrical Standards, 2011**

**26108-11 Raceways and Fittings**

**26109-11 Conductors and Cables**

**26111-11 Residential Electrical Services**

## **Identifying Panelboards and Switchboards**

### **Task Number 83**

#### **Identify purpose and location of overcurrent protective devices (OCPDs) and service entrance equipment.**

#### **Definition**

Identification should include

- listing the areas where OCPDs may be located in residential, commercial, and industrial facilities
- identifying OCPDs from structural plans, appliance wiring diagrams, and various available equipment

- differentiating between a short and an overload
- describing a blown fuse after a short and an overload
- selecting the proper OCPD
- locating and determining type of service equipment

according to NEC and industrial standards.

### **Process/Skill Questions**

- What is an OCPD, and what is its purpose?
- Where are the OCPDs found?
- What code article references the standard sizes for OCPD?
- What breaker size should be used on a 14 AWG wire?

# **Describing Generators and Power Supplies**

## **Task Number 84**

### **Explain principles of generating electricity.**

#### **Definition**

Explanation should include defining the principles of magnetism as applied to electricity, with examples of permanent and temporary magnets, completed in accordance with instructor's guidelines.

### **Process/Skill Questions**

- How is an electric magnet created?
- How is electricity produced and distributed to a house?
- What is a substation?
- What are the different sources used for producing electricity (solar, wind, nuclear, hydroelectric, fossil fuels)? What are the pros and cons of each?

a. , synthesizing, and critical-thinking questions before, during, and after reading texts.

### **NCCER Core Curriculum: Introductory Craft Skills, 2009**

#### **00102-09 Introduction to Construction Math**

### **NCCER Electrical Standards, 2011**

#### **26103-11 Introduction to Electrical Circuits**

#### **26104-11 Electrical Theory**

## **Task Number 85**

### **Explain principles of magnetism/electromagnetism.**

#### **Definition**

Explanation should include defining the principles of magnetism as applied to electricity, with examples of permanent and temporary magnets, completed in accordance with instructor's guidelines.

**NCCER Electrical Standards, 2011**

**26104-11 Electrical Theory**

## **Task Number 86**

### **Apply principles of generating electricity.**

#### **Definition**

Application must include

- identifying parts of a direct current (DC) generator
- identifying parts of an alternator
- obtaining manufacturer's nameplate data.

**NCCER Electrical Standards, 2011**

**26103-11 Introduction to Electrical Circuits**

**26104-11 Electrical Theory**

## **Task Number 87**

### **Identify components of a typical stand-alone generator.**

#### **Definition**

Identification should include transfer switch fuel sources (e.g., propane, natural gas) connection methods.

## **Exploring Environmentally Friendly Choices**

## **Task Number 88**

### **Identify energy-efficient equipment and methods.**

#### **Definition**

Identification should include

- refrigerators
- washer/dryers
- heat pumps
- solar panels
- wind turbines
- geothermal/heat/AC
- light-emitting diode (LED) lights
- fluorescent light bulbs.

#### **Process/Skill Questions**

- What are the pros and cons of using energy-efficient devices?
- What is an LED bulb?
- What is *geothermal*?
- What is the difference between a regular appliance and an ENERGY STAR appliance?
- What is a tankless water heater? What are the pros and cons of it?

## **Task Number 89**

### **Explore the environmental impacts of land use and site location for a proposed building project.**

#### **Definition**

Exploration should be based upon the predictable degradation to air, water, and soil and the subsequent stress on the ecological system caused by the construction and the structure as a continuing part of the environment. Exploration should consider managing site waste and construction byproducts to achieve diminishing environmental impacts and a higher degree of recyclability.

## **Task Number 90**

### **Explore design choices for a proposed building project that reflect conservation and efficient use of materials.**

## **Definition**

Exploration should include

- amount of materials needed
- type of materials desired
  - renewable
  - synthetic
  - reusable
- cost-effectiveness of material acquisition.

## **Task Number 91**

**Explore design choices for a proposed building project that reflect conservation and efficient use of energy.**

### **Definition**

Exploration should include

- energy performance policies
- building components (e.g., lighting, equipment, insulation, building envelope, windows)
- energy sources, including alternative and renewable
- energy trade-offs (e.g., the relationship between lighting power density sources and natural daylighting)
- energy usage, including energy performance measurement and monitoring.

## **Task Number 92**

**Explore design choices for a proposed building project that reflect conservation and efficient use of water.**

### **Definition**

Exploration should include

- water treatment (e.g., high-efficiency filtration systems)
- stormwater (e.g., the amount of impervious surfaces, gray water collection)
- irrigation demand (e.g., evapotranspiration, plant species factor).

## **Task Number 93**



# Explore design choices that can affect indoor air quality for proposed building projects.

## Definition

Exploration should include

- minimum ventilation requirements
- occupation density of building
- air filtration, including smoking control interior materials (e.g., paint and stain finishes, adhesives, flooring products).

## SOL Correlation by Task

39	Comply with federal, state, and local safety legal requirements.	English: 10.5, 11.5  History and Social Science: GOVT.9, GOVT.16  Science: BIO.1h, CH.1b
40	Maintain a safe working environment.	English: 10.5, 11.5
41	Explain safe working practices around electrical hazards.	English: 10.5, 11.5  History and Social Science: GOVT.9
42	Identify emergency first aid procedures.	English: 10.5, 11.5
43	Identify the types of fires and the methods used to extinguish them.	English: 10.5, 11.5  History and Social Science: GOVT.16
44	Identify personal protective equipment (PPE) requirements.	English: 10.5, 11.5
45	Inspect course-specific hand and power tools to visually identify defects.	English: 10.5, 11.5
46	Demonstrate lifting and carrying techniques.	English: 10.5, 11.5  History and Social Science: GOVT.16
47	Demonstrate safe laddering techniques.	
48	Demonstrate safe scaffolding techniques.	
49	Demonstrate lockout/tagout procedures.	English: 10.5, 11.5
50	Report injuries.	English: 10.6, 11.6
51	Report personal, environmental, and equipment safety violations to the appropriate authority.	English: 10.6, 11.6  History and Social Science: GOVT.9, GOVT.16

52	Earn the OSHA 10 card.	History and Social Science: GOVT.1, GOVT.9
53	Pass safety exam.	English: 10.5, 11.5
54	Explain electrician-specific safety issues.	English: 10.5, 11.5
55	Discuss current topics in the industry.	English: 10.5, 11.5  History and Social Science: VUS.14, WHII.14
56	Explore the various occupations available in electricity and related fields.	English: 10.5, 11.5
57	Investigate career opportunities in the electrical industry.	English: 10.5, 10.8, 11.5, 11.8
58	Discuss all postsecondary training and licensing in the electricity field.	English: 10.5, 11.5
59	Describe the employee's role in ensuring the success of the electrical business.	English: 10.5, 11.5
60	Identify national and local trade organizations.	English: 10.5, 11.5
61	Utilize the various types of hand tools used by electricians.	English: 10.5, 11.5
62	Utilize the various types of power tools used by electricians.	English: 10.5, 11.5
63	Identify commonly used materials by name and by regional variance of terminology.	
64	Prepare a material inventory.	
65	Explain basic electrical theory.	English: 10.5, 11.5  Science: PH.7b, PH.11c
66	Explain the relationship of electron theory to circuit design by the use of Ohm's Law.	English: 10.5, 11.5  Science: PH.7b, PH.11a
67	Use a variety of meters to take readings.	
68	Calculate series circuits.	Mathematics: A.4  Science: PH.11c
69	Wire a series circuit.	Science: PH.11c
70	Calculate parallel circuits.	Mathematics: A.4  Science: PH.11c
71	Wire parallel circuits.	Science: PH.11c
72	Solve word problems involving whole numbers, fractions, and decimals.	Mathematics: A.4
73	Solve algebraic formulas pertaining to electrical applications.	Mathematics: A.4  Science: PH.11a
74	Solve problems involving percentage, ratio, and proportion.	Mathematics: A.4
75	Measure distances using scales and measuring devices.	Mathematics: G.14
76	Draw electrical circuits.	Science: PH.11c
77	Read electrical construction drawings and specifications.	Science: PH.11c
78	Explain the intent of the NEC.	English: 10.5, 11.5
79	Interpret the NEC requirements for electrical installation.	English: 10.5, 11.5
80	Identify various types of conductors and their associated applications.	English: 10.5, 11.5

81	Install conductors.	English: 10.5, 11.5
82	Terminate conductors with lugs, connectors, or terminals.	English: 10.5, 11.5
83	Identify purpose and location of overcurrent protective devices (OCPDs) and service entrance equipment.	English: 10.5, 11.5
84	Explain principles of generating electricity.	English: 10.5, 11.5 Science: PH.1a, PH.4a, PH.7b
85	Explain principles of magnetism/electromagnetism.	English: 10.5, 11.5 Science: PH.1a
86	Apply principles of generating electricity.	Science: PH.1a, PH.4a, PH.7b
87	Identify components of a typical stand-alone generator.	Science: PH.1a
88	Identify energy-efficient equipment and methods.	English: 10.5, 11.5
89	Explore the environmental impacts of land use and site location for a proposed building project.	English: 10.5, 11.5 History and Social Science: GOVT.15, WG.3, WG.4, WG.16 Science: BIO.8d, ES.8a
90	Explore design choices for a proposed building project that reflect conservation and efficient use of materials.	English: 10.5, 11.5 History and Social Science: GOVT.15, WG.3, WG.4, WG.16 Science: BIO.8d, ES.6d
91	Explore design choices for a proposed building project that reflect conservation and efficient use of energy.	English: 10.5, 11.5 History and Social Science: GOVT.15, WG.3, WG.4, WG.16 Science: BIO.8d, ES.6b, ES.6c, ES.6d
92	Explore design choices for a proposed building project that reflect conservation and efficient use of water.	English: 10.5, 11.5 History and Social Science: GOVT.15, WG.3, WG.4, WG.16 Science: BIO.8d, ES.8e
93	Explore design choices that can affect indoor air quality for proposed building projects.	English: 10.5, 11.5 History and Social Science: GOVT.15, WG.3, WG.4, WG.16

## Green Building Infusion Units

The Green Building Infusion Unit (GBIU) was designed to encourage teachers to infuse instructional units on green building knowledge and skills into designated CTE courses. The infusion unit is not mandatory, and, as

such, the tasks/competencies are marked as “optional,” to be taught at the instructor’s discretion. Teachers can find the infusion/unit in the course listing.

## **Entrepreneurship Infusion Units**

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked “optional.” Teachers can find the infusion/unit in the course listing.

# Appendix: Credentials, Course Sequences, and Career Cluster Information

## Industry Credentials: Only apply to 36-week courses

- Certified Satellite Installer (CSI) Examination
- College and Work Readiness Assessment (CWRA+)
- Core: Introductory Craft Skills Entry-Level Assessment
- Customer Service Examination
- Customer Service Specialist (CSS) Examination
- Data Cabling Installer (DCI) Examination
- Electric Power and Distribution Assessment
- Electrical Construction Technology Assessment
- Electrical Construction Wiring (Residential Wiring) Examination
- Electrical Occupations Assessment
- Electrician Level One Entry-Level Assessment
- Fiber Optics Installer (FOI) Examination
- HBI/NAHB Residential Construction Academy (RCA) Series Student Certification Assessments
- ICC Certificates of Completion Examinations
- International Code Council Residential Electrical Inspector (E1) Examination
- National Career Readiness Certificate Assessment
- Network Cabling Specialist Certification Examinations
- Photovoltaic Installer - Level 1 (PV1) Examination
- Pre-Apprenticeship Certificate Training (PACT) Core Examinations
- Professional Communications Certification Examination
- Workplace Readiness Skills for the Commonwealth Examination

**Concentration sequences:** *A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.*

- Electricity II (8534/36 weeks, 280 hours)

Career Cluster: Architecture and Construction	
Pathway	Occupations
Construction	Construction Manager Electrician General Contractor
Design/Pre-Construction	Building Code Inspector Cost Estimator Electrical Engineering Technician