Electrical Apprenticeship Evaluation Tool

2020 Curricular Materials Review

Idaho CTE Trades and Industry (T&I) Electrical Apprenticeship Program Standards[[1]](#footnote-1)[[2]](#footnote-2)[[3]](#footnote-3)[[4]](#footnote-4)

**Publisher information**

* Publisher Name:
* Title:
* Grade Level:
* ISBN #:
* Author:
* Copyright:

# Instructions:

Complete the Publisher Standards Alignment Report below. Please provide written justification as to how the material meets the standard along with location references. If a justification requires additional space, please submit response on an additional document.

# Publisher STANDARDS ALIGNMENT Report:

## YEAR ONE Standard ELEC.1.0: Introduction to Electrical Work Safety

### YEAR ONE Performance Standard ELEC.1.1 General Safety

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.1.1.1 Explain what a material safety data sheet (MSDS/SDS) is and its requirements. |  |
| CTE ELEC.1.1.2 Explain safety procedures for trenches. |  |
| CTE ELEC.1.1.3 Explain safety for confined space. |  |
| CTE ELEC.1.1.4 Explain lockout and tagout. |  |
| CTE ELEC.1.1.5 Explain protective clothing to include eye and hearing protection. |  |
| CTE ELEC.1.1.6 Explain the use of a safety harness. |  |
| CTE ELEC.1.1.7 Explain safety for ladders and scaffolds. |  |
| CTE ELEC.1.1.8 State the purpose of arc-fault and ground-fault circuit interrupters. |  |
| CTE ELEC.1.1.9 Identify safety handling and use of hand and power tools. |  |

## YEAR ONE Standard ELEC.2.0: Electrical Theory

### YEAR ONE Performance Standard ELEC.2.1 Electrical Qualities and Ohm’s Law

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.1.1 Explain the structure of the atom. |  |
| CTE ELEC.2.1.2 Explain electron flow. |  |
| CTE ELEC.2.1.3 State the difference between insulators and conductors. |  |
| CTE ELEC.2.1.4 Explain the basic methods of producing electricity. |  |
| CTE ELEC.2.1.5 Describe electrical effects such as magnetism, light, and heat. |  |
| CTE ELEC.2.1.6 Define a coulomb. |  |
| CTE ELEC.2.1.7 Define an ampere. |  |
| CTE ELEC.2.1.8 Define an ohm. |  |
| CTE ELEC.2.1.9 Define a watt. |  |
| CTE ELEC.2.1.10 Determine the resistance of a resistor using the color code or an ohmmeter. |  |
| CTE ELEC.2.1.11 Determine whether a resistor is operating within its power rating. |  |
| CTE ELEC.2.1.12 Calculate different electrical values using Ohm’s law. |  |
| CTE ELEC.2.1.13 Select the proper Ohm’s law formula from a chart. |  |

### YEAR ONE Performance Standard ELEC.2.2 Static Electricity and Magnetism

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.2.1 Discuss the nature of static electricity. |  |
| CTE ELEC.2.2.2 Discuss lightning protection. |  |
| CTE ELEC.2.2.3 Give examples of both nuisance and useful static charges. |  |
| CTE ELEC.2.2.4 Discuss the properties of permanent magnets. |  |
| CTE ELEC.2.2.5 Discuss the operation of electromagnets. |  |
| CTE ELEC.2.2.6 Determine the polarity of an electromagnet when the direction of the current is known. |  |

## YEAR ONE Standard ELEC.3.0: Electrical Circuits

### YEAR ONE Performance Standard ELEC.3.1 Series

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.3.1.1 Discuss the properties of series circuits. |  |
| CTE ELEC.3.1.2 List three rules for solving electrical values of series circuits. |  |
| CTE ELEC.3.1.3 Calculate values of voltage, current, resistance, and power for series circuits. |  |

### YEAR ONE Performance Standard ELEC.3.2 Parallel

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.3.2.1 Discuss the characteristics of parallel circuits. |  |
| CTE ELEC.3.2.2 State three rules for solving electrical values of parallel circuits. |  |
| CTE ELEC.3.2.3 Solve the missing values in a parallel circuit using the three rules and Ohm’s law. |  |
| CTE ELEC.3.2.4 Calculate current values using the current divider formula. |  |

### YEAR ONE Performance Standard ELEC.3.3 Combination

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.3.3.1 Define a combination circuit. |  |
| CTE ELEC.3.3.2 List the rules for parallel circuits. |  |
| CTE ELEC.3.3.3 List the rules for series circuits |  |
| CTE ELEC.3.3.4 Solve combination circuits using the rules for parallel circuits, rules for series circuits, and Ohm’s law. |  |

## YEAR ONE Standard ELEC.4.0: Tools

### YEAR ONE Performance Standard ELEC.4.1 Electrical Testing Equipment

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.1.1 Identify the use of Category I through Category IV meters. |  |
| CTE ELEC.4.1.2 Use an ohmmeter and measure any resistance in electrical equipment or conductor. |  |
| CTE ELEC.4.1.3 Measure voltage between phases and phase to ground. |  |
| CTE ELEC.4.1.4 Take an ampere reading of any load. |  |
| CTE ELEC.4.1.5 Diagram the proper connection of a watt meter. |  |
| CTE ELEC.4.1.6 State the operation characteristics of analog and digital meters. |  |
| CTE ELEC.4.1.7 Recognize the wave form on an oscilloscope. |  |

### YEAR ONE Performance Standard ELEC.4.2 Bending Conduit

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.2.1 Identify the parts of tools used for bending. |  |
| CTE ELEC.4.2.2 Identify the methods and tools used in bending raceways. |  |
| CTE ELEC.4.2.3 Define and identify saddle, offset, concentric, and 90-degree bends. |  |

## YEAR ONE Standard ELEC.5.0: Introduction to the National Electrical Code (NEC)

### YEAR ONE Performance Standard ELEC.5.1 NEC Articles 90, 100, and 110

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.1.1 Understand how the NEC began and its purpose. |  |
| CTE ELEC.5.1.2 Understand how changes to the code evolve. |  |
| CTE ELEC.5.1.3 Understand the terminology, and format of the NEC. |  |
| CTE ELEC.5.1.4 State the roles of nationally recognized testing laboratories, the National Electrical Manufactures Association, and the National Fire Protection Association. |  |
| CTE ELEC.5.1.5 Accurately evaluate a location as accessible, readily accessible, or not readily accessible. |  |
| CTE ELEC.5.1.6 Identify equipment classified as appliances. |  |
| CTE ELEC.5.1.7 State the four categories of branch circuits. |  |
| CTE ELEC.5.1.8 State the difference between a continuous load and a non-continuous load. |  |
| CTE ELEC.5.1.9 Determine minimum vertical clearances for each installation using the NEC. |  |
| CTE ELEC.5.1.10 Apply dedicated space requirements to electrical equipment to include the area that is to be clear of foreign systems unless protection is provided. |  |
| CTE ELEC.5.1.11 Determine the working clearances of any installation using the NEC. |  |
| CTE ELEC.5.1.12 State the difference between a branch circuit and a feeder. |  |
| CTE ELEC.5.1.13 State the difference between “grounded” and “grounding” as it applies to a conductor. |  |
| CTE ELEC.5.1.14 Define what “in sight” means in the NEC. |  |
| CTE ELEC.5.1.15 Give examples of damp, wet, and dry locations using the code book. |  |
| CTE ELEC.5.1.16 Determine which conductors are the neutral conductors. |  |
| CTE ELEC.5.1.17 Define a separately derived system using the NEC. |  |

### YEAR ONE Performance Standard ELEC.5.2 Boxes and Enclosures – NEC Articles 312, 314, and Other Appropriate NEC Sections

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.2.1 Determine the cubic inch capacity of boxes when installing conductors # 6 AWG and smaller. |  |
| CTE ELEC.5.2.2 State which items use volume allowances of conductor fill when calculating box fill. |  |
| CTE ELEC.5.2.3 State how identical switches or receptacles can be mounted side by side, in a two gang box, can have different cubic inch volume allowances. |  |
| CTE ELEC.5.2.4 Determine the box size when the number of conductors is known. |  |
| CTE ELEC.5.2.5 Know the minimum conductor length to be left inside a box. |  |
| CTE ELEC.5.2.6 Explain what must be accessible after installation. |  |
| CTE ELEC.5.2.7 State the mounting and supporting provisions for boxes and conduit bodies using the NEC. |  |
| CTE ELEC.5.2.8 Determine the type of box needed for various applications using the NEC. |  |
| CTE ELEC.5.2.9 Calculate for junction box sizing containing #4 AWG and larger conductors using the NEC |  |

### YEAR ONE Performance Standard ELEC.5.3 Cables – NEC Articles 320 through 340, and Other Appropriate NEC Sections

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.3.1 State the distance from the edge of the wood framing member a cable can be installed unless a steel plate is installed. |  |
| CTE ELEC.5.3.2 State the requirements for protection of cable in metal framing using the NEC. |  |
| CTE ELEC.5.3.3 State the sealing requirements in fire-resistant-rated construction when electrical penetrations are made. |  |
| CTE ELEC.5.3.4 Identify what cables are permitted in spaces used for environmental air. |  |
| CTE ELEC.5.3.5 Determine the support requirements for MC, AC, and nonmetallic-sheathed cable using the NEC. |  |
| CTE ELEC.5.3.6 Identify the conductors in a cable and use the NEC to state how certain conductors can be re-identified. |  |
| CTE ELEC.5.3.7 Determine underground installation provisions per the NEC. |  |
| CTE ELEC.5.3.8 Identify special application cables using the NEC (This is not to be for installation requirements as this is for first year students). |  |

### YEAR ONE Performance Standard ELEC.5.4 Raceways and Conductors – NEC Sections 11.14, 240.4, 300.19; NEC Articles 310, 342 through 378; Chapter 9 tables; Annex C, and Other Appropriate sections

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.4.1 Determine the general provisions for any raceway installation using the NEC. |  |
| CTE ELEC.5.4.2 Determine the type of raceways suited for individual installations. |  |
| CTE ELEC.5.4.3 Determine the support requirements for various raceways using the NEC. |  |
| CTE ELEC.5.4.4 Determine the provisions for nonmetallic and metallic flexible conduit using the NEC. |  |
| CTE ELEC.5.4.5 Calculate the electrical trade size conduit required for any circuit or feeder. |  |
| CTE ELEC.5.4.6 Determine basic conductor properties using the NEC. |  |
| CTE ELEC.5.4.7 Show conductor temperature limitations. |  |
| CTE ELEC.5.4.8 Determine the provisions for conductors connected in parallel. |  |
| CTE ELEC.5.4.9 Apply conductor ampacity correction factors to include continuous loads. |  |

### YEAR ONE Performance Standard ELEC.5.5 General Provisions For One-family Dwellings – NEC Articles 210, 220, 240, 250, 315, 402, 404, 406, 410, 422, and Other Appropriate NEC Sections

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.5.1 Calculate the minimum number of 15 and 20 amp branch circuits in a one-family dwelling. |  |
| CTE ELEC.5.5.2 Determine the requirements for single receptacles on individual branch circuits. |  |
| CTE ELEC.5.5.3 Determine the branch-circuit ratings allowed for general-purpose receptacles. |  |
| CTE ELEC.5.5.4 Demonstrate the layout of general-purpose receptacles in a dwelling. |  |
| CTE ELEC.5.5.5 Determine the receptacle rating allowed on various size branch circuits using the NEC. |  |
| CTE ELEC.5.5.6 Determine the requirements for receptacles around sink areas using the NEC. |  |
| CTE ELEC.5.5.7 Determine the requirements for lighting and switching using the NEC. |  |
| CTE ELEC.5.5.8 Determine how and when to use the white conductor as an ungrounded conductor. |  |
| CTE ELEC.5.5.9 Determine any general requirement for boxes using the NEC. |  |
| CTE ELEC.5.5.10 Determine any illumination requirement for entrances and exits. |  |
| CTE ELEC.5.5.11 Determine the allowable use of vegetation such as trees for the mounting of outlets. |  |

### YEAR ONE Performance Standard ELEC.5.6 Specific Provisions for One-family Dwellings – NEC Articles 210, 410, 422, and Other Appropriate NEC Sections

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.6.1 Determine the required ampere rating for any receptacle or branch circuit in kitchens, pantries, dining rooms, breakfast rooms, and similar locations. |  |
| CTE ELEC.5.6.2 Determine the requirements for countertop receptacle placement using the NEC. |  |
| CTE ELEC.5.6.3 State the minimum number of small appliance branch circuits required and their application. |  |
| CTE ELEC.5.6.4 Determine the requirements for appliances both cord and plug and permanently connected. |  |
| CTE ELEC.5.6.5 Calculate the load requirements for appliance branch circuits. |  |
| CTE ELEC.5.6.6 State the specific provisions for GFCI placement. |  |
| CTE ELEC.5.6.7 Identify luminaries permitted in closets and its placement. |  |
| CTE ELEC.5.6.8 Define a bathroom by the NEC and discuss the circuit requirements for receptacles, lights, and fans. |  |
| CTE ELEC.5.6.9 Determine the requirements for receptacles and lighting in attached garages, detached garages, and basements. |  |
| CTE ELEC.5.6.10 Determine the requirements for laundry rooms to include the clothes dryer. |  |
| CTE ELEC.5.6.11 Determine the lighting and receptacle requirements for attic, crawl space, and HVAC equipment. |  |

### YEAR ONE Performance Standard ELEC.5.7 Load Calculations for One-family Dwellings – NEC Articles, 210, 220, 230, 250, 310, and Other Appropriate NEC Sections

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.7.1 Calculate the general lighting for a one-family dwelling. |  |
| CTE ELEC.5.7.2 Specify the volt-amp requirements for small appliance and laundry branch circuits. |  |
| CTE ELEC.5.7.3 Apply demand factors to the general lighting load. |  |
| CTE ELEC.5.7.4 Apply demand factors to fastened-in-place appliances. |  |
| CTE ELEC.5.7.5 Calculate feeder demand loads for household clothes dryers. |  |
| CTE ELEC.5.7.6 Calculate feeder demand loads for household cooking equipment. |  |
| CTE ELEC.5.7.7 Calculate feeder demand loads for HVAC equipment. |  |
| CTE ELEC.5.7.8 Calculate a one-family dwelling or feeder using the standard method. |  |
| CTE ELEC.5.7.9 Calculate a one-family dwelling or feeder using the optional method. |  |
| CTE ELEC.5.7.10 Calculate service and feeder conductors. |  |
| CTE ELEC.5.7.11 Calculate the minimum size neutral conductor. |  |
| CTE ELEC.5.7.12 Select the proper grounding electrode conductor. |  |

### YEAR ONE Performance Standard ELEC.5.8 Services and Electrical Equipment for One-family Dwellings – NEC Articles, 110, 225, 230, 240, 250, 300, 310, and Other Appropriate NEC Sections

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.8.1 Determine adequate strength for a mast supporting service-drop conductors. |  |
| CTE ELEC.5.8.2 Explain the use of service-entrance cable. |  |
| CTE ELEC.5.8.3 Define a service lateral and underground service conductors, and explain their provisions. |  |
| CTE ELEC.5.8.4 Determine clearances for service and outside overhead wiring. |  |
| CTE ELEC.5.8.5 Determine work space required for electrical equipment, services, and panels. |  |
| CTE ELEC.5.8.6 Define a panelboard, an enclosure, and a cutout box. |  |
| CTE ELEC.5.8.7 Determine the proper application and use of circuit breakers and fuses using the NEC. |  |
| CTE ELEC.5.8.8 Determine the appropriate conductor sizing using 310.15(B) (7) or Table 310.15 (B) (16). |  |
| CTE ELEC.5.8.9 Size the grounding electrode conductor, equipment grounding conductor, main bonding jumper, bonding jumpers on the supply side or load side of the main breaker or fuse on any one-family dwelling service. |  |
| CTE ELEC.5.8.10 Properly install grounded and grounding conductors in subpanels. |  |
| CTE ELEC.5.8.11 Prevent objectionable current flow in grounding conductors and equipment. |  |
| CTE ELEC.5.8.12 Properly install a panelboard in a separate building or structure. |  |

### YEAR ONE Performance Standard ELEC.5.9 Comprehensive Provisions for Multi-family Dwellings – NEC Articles, 210, 230, 240, 250, 310, Chapter 9, Tables 8 and 9, and Other Appropriate NEC Sections

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.9.1 Determine when more than one service can be installed on a multifamily building. |  |
| CTE ELEC.5.9.2 Determine the proper number of disconnects allowed on a service. |  |
| CTE ELEC.5.9.3 Determine proper access to a unit’s disconnecting means by any occupant. |  |
| CTE ELEC.5.9.4 Properly install the grounding electrode conductors to the grounding electrode. |  |
| CTE ELEC.5.9.5 Determine the appropriate service or feeder conductor sizing using 310.15(B)(7) or Table 310.15 (B)(16) Determine outdoor receptacle placement. |  |
| CTE ELEC.5.9.6 Calculate voltage-drop. |  |

### YEAR ONE Performance Standard ELEC.5.10 General Provisions for Commercial Locations – NEC Articles, 210, 220, 310, 410, 430, 440, 600, and Other Appropriate NEC Sections

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.10.1 Compare receptacle placement with that of one-family dwellings to show the difference. |  |
| CTE ELEC.5.10.2 Determine the receptacle requirements in a commercial bathroom. |  |
| CTE ELEC.5.10.3 Determine the sign outlet requirements in a commercial installation. |  |
| CTE ELEC.5.10.4 Determine the branch circuit requirements for motors and HVAC equipment. |  |
| CTE ELEC.5.10.5 Determine the volt-amp ratings for receptacles (single, duplex, quad, etc.). |  |
| CTE ELEC.5.10.6 Determine the maximum number of receptacles permitted on a 15 amp or 20 amp circuit. |  |
| CTE ELEC.5.10.7 Identify the NEC accessibility requirements for receptacles in guest rooms of hotels and motels. |  |
| CTE ELEC.5.10.8 Determine NEC requirements for showcase and show window. |  |
| CTE ELEC.5.10.9 Calculate general lighting load based on square-foot area. |  |
| CTE ELEC.5.10.10 Determine the provisions for fluorescent, HID, recessed, LED, and track lighting provisions. |  |
| CTE ELEC.5.10.11 Determine the proper use and restrictions when using luminaires as raceways. |  |
| CTE ELEC.5.10.12 Determine handhole access requirements. |  |

### YEAR ONE Performance Standard ELEC.5.11 Provisions for Services, Feed – NEC Articles, 210, 220, 310, 410, 430, 440, 600, and Other Appropriate NEC Sections

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.11.1 Properly install both grounding and grounded conductors on the line side and load side of the service supply conductors. |  |
| CTE ELEC.5.11.2 Determine the conditions that require ground-fault protection of equipment. |  |
| CTE ELEC.5.11.3 Recognize separately derived systems. |  |
| CTE ELEC.5.11.4 Explain how to properly ground and bond separately derived systems. |  |
| CTE ELEC.5.11.5 Recognize and explain the use of busways. |  |

## YEAR ONE Standard ELEC.6.0: Special Occupancies

### YEAR ONE Performance Standard ELEC.6.1 Hazardous Locations – NEC Articles 600 through 516

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.6.1.1 Explain what a hazardous location is. |  |
| CTE ELEC.6.1.2 Determine if a classified location is Class I, II or III and if it is Division 1 or 2 using the NEC. |  |
| CTE ELEC.6.1.3 Identify the NEC requirements pertaining to commercial garages and repair and storage facilities. |  |
| CTE ELEC.6.1.4 Identify the NEC requirements for buildings in which aircraft are stored and repaired. |  |
| CTE ELEC.6.1.5 Identify the NEC requirements for a motor fuel dispensing facility. |  |

### YEAR ONE Performance Standard ELEC.6.2 Health Care – NEC Articles 500 through 517

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.6.2.1 Identify basic health care terminology used in NEC. |  |
| CTE ELEC.6.2.2 Determine the grounding and bonding requirements of any health care facility. |  |
| CTE ELEC.6.2.3 Identify patient care areas as general care or critical care and their branch circuit requirements. |  |
| CTE ELEC.6.2.4 Determine the tamper-resistant requirements of pediatric facilities. |  |
| CTE ELEC.6.2.5 Define the types of essential systems. |  |

### YEAR ONE Performance Standard ELEC.6.3 Other Special Occupancies – NEC Articles 518 through 551

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.6.3.1 Define “places of assembly” according to the NEC. |  |
| CTE ELEC.6.3.2 Determine manufactured building requirements. |  |
| CTE ELEC.6.3.3 Determine agricultural building requirements. |  |
| CTE ELEC.6.3.4 Determine requirements for mobile home parks and recreational vehicle parks. |  |

## YEAR TWO Standard ELEC.1.0: Electrical Mathematics

### YEAR TWO Performance Standard ELEC.1.1 Basic Trigonometry

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.1.1.1 Define a right triangle. |  |
| CTE ELEC.1.1.2 Use the Pythagorean theorem to solve problems concerning right triangles. |  |
| CTE ELEC.1.1.3 Solve problems using sines, cosines, and tangents. |  |

## YEAR TWO Standard 2.0: Alternating Current

### YEAR TWO Performance Standard ELEC.2.1 Circuits

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.1.1 Discuss the difference between AC and DC. |  |
| CTE ELEC.2.1.2 Compute instantaneous values of voltage and current for a sine wave. |  |
| CTE ELEC.2.1.3 Compute peak, RMS, and average values of voltage and current. |  |
| CTE ELEC.2.1.4 Define the phase relationship of voltage and current in a pure resistive circuit. |  |
| CTE ELEC.2.1.5 Identify half-wave and full-wave rectifiers. |  |

### YEAR TWO Performance Standard ELEC.2.2 Inductance in AC Circuits

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.2.1 Define the properties of inductance in an AC circuit. |  |
| CTE ELEC.2.2.2 Define inductive reactance. |  |
| CTE ELEC.2.2.3 Calculate the values of inductive reactance and inductance. |  |
| CTE ELEC.2.2.4 Define the relationship of voltage and current in a pure inductive circuit. |  |
| CTE ELEC.2.2.5 Calculate values for inductors connected in series and parallel. |  |
| CTE ELEC.2.2.6 Define reactive power. |  |
| CTE ELEC.2.2.7 Define the Q of a coil. |  |

### YEAR TWO Performance Standard ELEC.2.3 Resistive-Inductive Series Circuits

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.3.1 Define the relationship of resistance and inductance in an AC circuit. |  |
| CTE ELEC.2.3.2 Define power factor. |  |
| CTE ELEC.2.3.3 Calculate the values of voltage, current, apparent power, true power, reactive power, impedance, resistance, inductive reactance, and power factor in an RL series circuit. |  |
| CTE ELEC.2.3.4 Calculate the phase angle for current and voltage in an RL circuit. |  |

### YEAR TWO Performance Standard ELEC.2.4 Resistive-Inductive Parallel Circuits

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.4.1 Define the operation of a parallel circuit containing resistance and inductance. |  |
| CTE ELEC.2.4.2 Calculate the values of voltage, current, apparent power, true power, reactive power, impedance, resistance, inductive reactance, and power factor in an RL parallel circuit. |  |
| CTE ELEC.2.4.3 Calculate the phase angle for current and voltage in an RL parallel circuit. |  |

### YEAR TWO Performance Standard ELEC.2.5 Capacitors

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.5.1 List three factors that determine the capacitance of a capacitor. |  |
| CTE ELEC.2.5.2 Discuss the electrostatic charge. |  |
| CTE ELEC.2.5.3 State the difference between polarized and non-polarized capacitors. |  |
| CTE ELEC.2.5.4 Calculate the values for series and parallel connections of capacitors. |  |

### YEAR TWO Performance Standard ELEC.2.6 Capacitance in AC Circuits

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.6.1 Understand how capacitors function in an AC circuit. Understand how capacitors function in an AC circuit. |  |
| CTE ELEC.2.6.2 Define capacitive reactance. |  |
| CTE ELEC.2.6.3 Calculate the value of capacitive reactance in an AC circuit. |  |
| CTE ELEC.2.6.4 Calculate the value of capacitance in an AC circuit. |  |
| CTE ELEC.2.6.5 Identify the relationship of voltage and resistance in an AC circuit. |  |
| CTE ELEC.2.6.6 Calculate the phase angle for current and voltage in an AC circuit. |  |

### YEAR TWO Performance Standard ELEC.2.7 Resistive-Capacitive Series Circuits

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.7.1 Identify the relationship of resistance and capacitance in an AC series circuit. |  |
| CTE ELEC.2.7.2 Calculate the values of voltage, current, apparent power, true power, reactive power, impedance, resistance, inductive reactance, and power factor in an RC series circuit. |  |
| CTE ELEC.2.7.3 Calculate the phase angle for current and voltage in an RC series circuit. |  |

### YEAR TWO Performance Standard ELEC.2.8 Resistive-Capacitive Parallel Circuits

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.8.1 Define the operation of a parallel circuit containing resistance and capacitance. |  |
| CTE ELEC.2.8.2 Calculate the values of voltage, current, apparent power, true power, reactive power, impedance, resistance, inductive reactance, power factor, and phase angle in an RC parallel circuit. |  |

### YEAR TWO Performance Standard ELEC.2.9 Resistive-Inductive-Capacitive Parallel Circuits

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.9.1 Identify the characteristics of AC circuits that contain resistance, inductance, and capacitance connected in parallel. |  |
| CTE ELEC.2.9.2 Calculate the values of voltage, current, apparent power, true power, reactive power, impedance, resistance, inductive reactance, power factor, and phase angle in an RLC parallel circuit. |  |

### YEAR TWO Performance Standard ELEC.2.10 Three-phase Circuits

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.10.1 Identify the difference between single-phase and three-phase voltages. |  |
| CTE ELEC.2.10.2 Identify a three-phase delta or wye connection. |  |
| CTE ELEC.2.10.3 Calculate the voltage and current values for wye and delta circuits. |  |

### YEAR TWO Performance Standard ELEC.2.11 Single-phase Transformers

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.11.1 Understand the different types of transformers and how they work. |  |
| CTE ELEC.2.11.2 Calculate the values of voltage, current, and turns for a single-phase transformer. |  |
| CTE ELEC.2.11.3 Understand the polarity markings. |  |

### YEAR TWO Performance Standard ELEC.2.12 Three-phase Transformers

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.12.1 Identify the proper connections for three single-phase transformers to form a three-phase bank. |  |
| CTE ELEC.2.12.2 Calculate voltage and current for three-phase transformer connections. |  |
| CTE ELEC.2.12.3 Identify the proper connections for two single phase transformers to form a three-phase open-delta connection. |  |
| CTE ELEC.2.12.4 Calculate the values of voltage and current for a three-phase transformer used to supply both three-phase and single-phase loads. |  |
| CTE ELEC.2.12.5 Define harmonics. |  |
| CTE ELEC.2.12.6 Understand harmonic problems and their solution. |  |

## **YEAR TWO STANDARD ELEC.3.0: MOTORS**

### YEAR TWO Performance Standard ELEC.3.1 Three-phase Motors

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.3.1.1 Understand the basic operating principals of a three-phase motor. |  |
| CTE ELEC.3.1.2 Define a rotating magnetic field. |  |
| CTE ELEC.3.1.3 Define the operating principals of a squirrel-cage motor. |  |
| CTE ELEC.3.1.4 Identify the correct connections for dual voltage motors. |  |
| CTE ELEC.3.1.5 Define the procedure for reversing a three-phase motor. |  |

### YEAR TWO Performance Standard ELEC.3.2 Single-phase Motors

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.3.2.1 Define the operation of various motor types. |  |
| CTE ELEC.3.2.2 Define the basic operation of a split-phase motor. |  |
| CTE ELEC.3.2.3 Understand the purpose of a start winding and how it works. |  |
| CTE ELEC.3.2.4 Understand the purpose of a centrifugal switch. |  |
| CTE ELEC.3.2.5 Recognize the types of starting relays. |  |

### YEAR TWO Performance Standard ELEC.3.3 Motor Load Calculations as per NEC

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.3.3.1 Determine the full load current of any motor according to the NEC. |  |
| CTE ELEC.3.3.2 Understand the information given on a motor nameplate and its application. |  |
| CTE ELEC.3.3.3 Calculate the branch circuit wire size for any motor. |  |
| CTE ELEC.3.3.4 Determine the appropriate circuit protection for any motor. |  |
| CTE ELEC.3.3.5 Calculate overloads. |  |
| CTE ELEC.3.3.6 Understand the difference between overload protection and short-circuit/ground-fault protection. |  |
| CTE ELEC.3.3.7 Calculate a feeder for any set of motors. |  |
| CTE ELEC.3.3.8 Calculate the feeder overcurrent device. |  |

## **YEAR TWO STANDARD ELEC.4.0: NEC COMPLIANCE**

### YEAR TWO Performance Standard ELEC.4.1 Box Fill and Junction Box Sizing

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.1.1 Calculate box fill for any size wire and combination of devices. |  |
| CTE ELEC.4.1.2 Calculate pull and junction boxes. |  |

### YEAR TWO Performance Standard ELEC.4.2 Conductor Ampacity Correction Factors

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.2.1 Calculate correction factors for temperature. |  |
| CTE ELEC.4.2.2 Calculate correction factors for raceway fill. |  |
| CTE ELEC.4.2.3 Calculate correction factors for continuous loads. |  |
| CTE ELEC.4.2.4 Calculate correction factors for any combination of the above. |  |
| CTE ELEC.4.2.5 Use Table 310.15(B) (16) and similar tables. |  |
| CTE ELEC.4.2.6 Apply NEC Chapter 9 notes for derate in nipples. |  |

### YEAR TWO Performance Standard ELEC.4.3 Raceway Fill

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.3.1 Use NEC tables to calculate raceway fill using any combination of wire and cable sizes. |  |
| CTE ELEC.4.3.2 Use Annex C tables. |  |
| CTE ELEC.4.3.3 Calculate conduit nipple fill. |  |

### YEAR TWO Performance Standard ELEC.4.4 Grounding and Bonding

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.4.1 Define objectionable current. |  |
| CTE ELEC.4.4.2 Identify a main bonding jumper. |  |
| CTE ELEC.4.4.3 Calculate the grounding electrode conductor. |  |
| CTE ELEC.4.4.4 Identify proper installations of grounding electrode systems. |  |
| CTE ELEC.4.4.5 Understand the purpose of bonding. |  |
| CTE ELEC.4.4.6 Calculate equipment grounding conductors. |  |
| CTE ELEC.4.4.7 Use Article 250 to properly ground and bond any system. |  |
| CTE ELEC.4.4.8 Use the NEC to answer any grounding question. |  |

## **YEAR THREE STANDARD ELEC.1.0: GENERAL ELECTRICAL SAFETY**

### YEAR THREE Performance Standard ELEC.1.1 Safety and NFPA 70E

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.1.1.1 Achieve an electrically safe work condition. |  |
| CTE ELEC.1.1.2 Interpret arc flash labeling. |  |
| CTE ELEC.1.1.3 Choose appropriate levels of PPE for the hazard. |  |
| CTE ELEC.1.1.4 Describe the steps to verify your testing equipment. |  |
| CTE ELEC.1.1.5 Explain lockout and tagout procedures. |  |
| CTE ELEC.1.1.6 Identify the use of Category I through Category IV meters. |  |
| CTE ELEC.1.1.7 Identify proper meter maintenance. |  |
| CTE ELEC.1.1.8 Explain the use of a safety harness. |  |
| CTE ELEC.1.1.9 Explain safety for ladders and scaffolds. |  |
| CTE ELEC.1.1.10 Explain what a material safety data sheet (MSDS/SDS) is and its requirements. |  |
| CTE ELEC.1.1.11 Explain safety procedures for trenches. |  |
| CTE ELEC.1.1.12 Explain safety for confined space. |  |
| CTE ELEC.1.1.13 Explain protective clothing to include eye and hearing protection. |  |
| CTE ELEC.1.1.14 State the purpose of arc‐fault and ground‐fault circuit interrupters. |  |
| CTE ELEC.1.1.15 Identify safety handling and use of hand and power tools. |  |

## YEAR THREE STANDARD ELEC.2.0: BLUEPRINTS

### YEAR THREE Performance Standard ELEC.2.1 Print Reading Fundamentals

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.1.1 Recognize site plan, floor plans, elevations, sectional views, wiring diagrams, details, and schedules. |  |
| CTE ELEC.2.1.2 Recognize types of electrical schedules to include fixtures, feeders, main switchboard, branch circuit panels, and transformers. |  |
| CTE ELEC.2.1.3 Demonstrate the application of building plans and specifications. |  |
| CTE ELEC.2.1.4 Locate specific information on building plans. |  |
| CTE ELEC.2.1.5 Research additional information from industry‐related resources. |  |

### YEAR THREE Performance Standard ELEC.2.2 Residential and Commercial Electrical Symbols

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.2.1 Read and interpret electrical symbols used in construction drawings. |  |
| CTE ELEC.2.2.2 Identify the electrical installation requirements for a building from symbols. |  |
| CTE ELEC.2.2.3 Determine aboveground and underground electrical distribution. |  |
| CTE ELEC.2.2.4 Determine electrical materials, measurements, and specifications. |  |

### YEAR THREE Performance Standard ELEC.2.3 Electrical Drawings and Plans

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.3.1 Differentiate between the purposes and characteristics of drawings, plans, and diagrams. |  |
| CTE ELEC.2.3.2 Describe the purpose of and list the primary features included on each type of drawing and plan to include floor plans, pictorial drawings, orthographic elevations, orthographic views, application drawings, location drawings, detail drawings, assembly drawings, site plans, foundation plans, structural plans, and utility plans. |  |
| CTE ELEC.2.3.3 Identify the proper drawing or plan for the application. |  |

### YEAR THREE Performance Standard ELEC.2.4 Construction and Maintenance

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.4.1 Describe the different responsibilities of various construction personnel. |  |
| CTE ELEC.2.4.2 Identify the major steps on the construction process. |  |
| CTE ELEC.2.4.3 Describe the different responsibilities of various maintenance personnel. |  |
| CTE ELEC.2.4.4 Compare preventive and predictive maintenance. |  |

### YEAR THREE Performance Standard ELEC.2.5 Residential and Commercial Power and Lighting Systems

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.5.1 Compare how power and lighting information is included on residential and commercial plans. |  |
| CTE ELEC.2.5.2 Describe the types of electrical equipment included on single‐line diagrams. |  |
| CTE ELEC.2.5.3 Describe the typical information included on light fixture schedules and how this information is linked to floor plans. |  |
| CTE ELEC.2.5.4 Describe the common types of electrical detail drawings. |  |

## **YEAR THREE STANDARD ELEC.3.0: LOAD CALCULATIONS**

### YEAR THREE Performance Standard ELEC.3.1 Single Family Dwelling Unit Calculations

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.3.1.1 Properly define a one‐family dwelling. |  |
| CTE ELEC.3.1.2 Calculate the general lighting, general use receptacle, small appliance, and laundry demand load for a dwelling. |  |
| CTE ELEC.3.1.3 Calculate the appliance demand load for a dwelling. |  |
| CTE ELEC.3.1.4 Determine the dryer demand load for a dwelling. |  |
| CTE ELEC.3.1.5 Determine the cooking appliance demand load for a dwelling. |  |
| CTE ELEC.3.1.6 Determine the heating and air conditioning demand load for a dwelling. |  |
| CTE ELEC.3.1.7 Properly size the service equipment and service conductors for a dwelling using the standard calculation as per Article 220. |  |
| CTE ELEC.3.1.8 Properly size feeder conductors (main to sub‐panel) for a dwelling. |  |
| CTE ELEC.3.1.9 Use the optional calculation for a dwelling as per Article 220. |  |
| CTE ELEC.3.1.10 Calculate and size the service neutral conductor in a dwelling (neutral load). |  |

### YEAR THREE Performance Standard ELEC.3.2 Multifamily Dwelling Calculations

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.3.2.1 Properly define a multifamily dwelling. |  |
| CTE ELEC.3.2.2 Calculate the general lighting, general use receptacle, small appliance, and laundry demand load for a multifamily dwelling. |  |
| CTE ELEC.3.2.3 Calculate the appliance demand load for a multifamily dwelling. |  |
| CTE ELEC.3.2.4 Determine the dryer demand load for a multifamily dwelling. |  |
| CTE ELEC.3.2.5 Determine the cooking appliance demand load for a multifamily dwelling. |  |
| CTE ELEC.3.2.6 Determine the heating and air conditioning demand load for a multifamily dwelling. |  |
| CTE ELEC.3.2.7 Properly size the service equipment and service conductors for a multifamily dwelling using the standard calculation as per Article 220. |  |
| CTE ELEC.3.2.8 Properly size feeder conductors (main to sub‐panel) for a multifamily dwelling. |  |
| CTE ELEC.3.2.9 Use the optional calculation for a multifamily dwelling as per Article 220. |  |
| CTE ELEC.3.2.10 Calculate and size the service neutral conductor in a multifamily dwelling (neutral load). |  |

### YEAR THREE Performance Standard ELEC.3.3 Commercial Calculations

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.3.3.1 Determine the lighting demand factor for any commercial building to include stores, hotels and motels, warehouses, hospitals, office buildings, schools, restaurants, etc. |  |
| CTE ELEC.3.3.2 Determine sign and show‐window demand loads. |  |
| CTE ELEC.3.3.3 Determine the demand loads for multi‐outlet assemblies. |  |
| CTE ELEC.3.3.4 Determine the receptacle demand loads for offices and banks. |  |
| CTE ELEC.3.3.5 Determine the receptacle demand load for general commercial applications. |  |
| CTE ELEC.3.3.6 Determine the demand loads for commercial kitchens. |  |
| CTE ELEC.3.3.7 Use the optional method for commercial demand load calculations. |  |
| CTE ELEC.3.3.8 Determine the demand load for manufactured home parks, recreational vehicle parks, and marinas. |  |
| CTE ELEC.3.3.9 Determine the ampacity of conductors based on the type of special equipment (e.g., welders, electrical vehicles, HVAC, signs, etc.). |  |
| CTE ELEC.3.3.10 Determine the service size for any commercial installation. |  |

## **YEAR THREE STANDARD ELEC.4.0: CONDUCTOR CALCULATIONS**

### YEAR THREE Performance Standard ELEC.4.1 Conductor Calculations

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.1.1 Determine the cross‐sectional a rea of any conductor using NEC Chapter 9, table 5. |  |
| CTE ELEC.4.1.2 Determine the cross‐sectional area of compact conductors using NEC Chapter 9, Table 5(A). |  |
| CTE ELEC.4.1.3 Understand and apply raceway fill limitations. |  |
| CTE ELEC.4.1.4 Size any raceway for the required wire fill. |  |
| CTE ELEC.4.1.5 Define and size raceway nipples for required wire fill. |  |
| CTE ELEC.4.1.6 Calculate conductor fill when using various sizes and/or types of conductors. |  |
| CTE ELEC.4.1.7 Calculate raceway size for multi‐conductor and optical fiber cables. |  |
| CTE ELEC.4.1.8 Determine raceway fill using Annex C of the NEC. |  |
| CTE ELEC.4.1.9 Size a wireway for conductor fill. |  |
| CTE ELEC.4.1.10 Properly size an outlet or junction box based on wire fill. |  |
| CTE ELEC.4.1.11 Properly calculate the box fill of conductors, clamps, support fittings, devices or equipment, and grounding conductors. |  |
| CTE ELEC.4.1.12 Size pull and junction boxes for 4 AWG and larger wire. |  |
| CTE ELEC.4.1.13 Install conduits containing the same conductors the correct distance apart (4 AWG and larger). |  |
| CTE ELEC.4.1.14 Properly size the depth of pull boxes and conduit bodies when conductors enter opposite a removable cover. |  |

### YEAR THREE Performance Standard ELEC.4.2 Conductor Sizing and Protection Calculations

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.2.1 Determine conductor properties. |  |
| CTE ELEC.4.2.2 Determine applications of insulation types based on NEC. |  |
| CTE ELEC.4.2.3 Determine conductor size for loads. |  |
| CTE ELEC.4.2.4 Determine conductor sizing based on the termination temperature rating. |  |
| CTE ELEC.4.2.5 Properly size the overcurrent device for loads. |  |
| CTE ELEC.4.2.6 Properly apply NEC Article 240 rules for small conductors. |  |
| CTE ELEC.4.2.7 Apply ampacity adjustment factors for temperature, wire fill, etc. |  |
| CTE ELEC.4.2.8 Identify when the neutral conductor is counted as current carrying when applying ampacity adjustment factors. |  |
| CTE ELEC.4.2.9 Apply ampacity adjustment to wireways. |  |
| CTE ELEC.4.2.10 Size conductors for continuous loads after ampacity adjustment. |  |
| CTE ELEC.4.2.11 Properly size feeders based on loads and adjustment factors. |  |
| CTE ELEC.4.2.12 Properly size tap conductors using the 10‐ and 25‐foot rules (NEC Article 240). |  |

### YEAR THREE Performance Standard ELEC.4.3 Voltage Drop Calculations

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.3.1 State the recommended voltage drop according the NEC. |  |
| CTE ELEC.4.3.2 Use the information in Chapter 9, Table 8 to calculate the resistance of any conductor based on size and length. |  |
| CTE ELEC.4.3.3 Use the voltage drop formulas for single‐phase and three‐phase systems. |  |
| CTE ELEC.4.3.4 Size conductors to account for voltage drop. |  |

### YEAR THREE Performance Standard ELEC.4.4 Motors: Article 430 of the NEC

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.4.1 Determine the full load current of any motor according to the NEC. |  |
| CTE ELEC.4.4.2 Size the branch circuit wire size for any motor. |  |
| CTE ELEC.4.4.3 Determine the appropriate circuit protection for any motor. |  |
| CTE ELEC.4.4.4 Use the motor name plate to size overloads. |  |
| CTE ELEC.4.4.5 Explain the difference between overload protection and short‐circuit/ground‐fault protection. |  |
| CTE ELEC.4.4.6 Size a feeder for any set of motors. |  |
| CTE ELEC.4.4.7 Size the feeder short‐circuit/ground‐fault overcurrent device. |  |

### YEAR THREE Performance Standard ELEC.4.5 Transformers: Article 450 of the NEC

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.5.1 Calculate the high leg voltage of a delta‐connected transformer. |  |
| CTE ELEC.4.5.2 Calculate the primary and secondary line current of single‐ and three‐phase transformers. |  |
| CTE ELEC.4.5.3 Calculate the primary and secondary overcurrent protection for a transformer. |  |
| CTE ELEC.4.5.4 Calculate and select the proper conductor size for the primary and secondary of a transformer. |  |
| CTE ELEC.4.5.5 Properly size the grounding electrode conductor and bonding jumpers. |  |

## **YEAR THREE STANDARD ELEC.5.0: MOTOR CONTROLS**

### YEAR THREE Performance Standard ELEC.5.1 Basic Principles of Motor Controls

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.1.1 Recognize ladder diagrams. |  |
| CTE ELEC.5.1.2 Recognize wiring/connection diagrams. |  |
| CTE ELEC.5.1.3 Recognize pictorial diagrams. |  |
| CTE ELEC.5.1.4 Use and interpret definitions, abbreviations, and graphic symbols used on motor control diagrams. |  |
| CTE ELEC.5.1.5 Describe the function of pushbutton stations, solenoids, flow switches, pressure switches, limit switches, and timing relays. |  |
| CTE ELEC.5.1.6 Define the basic operation of variable frequency drives. |  |

### YEAR THREE Performance Standard ELEC.5.2 Components of Magnetic Control Circuits

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.2.1 Use a ladder diagram to illustrate a simple two‐wire control circuit for a single‐phase motor operated by a float switch or similar device. |  |
| CTE ELEC.5.2.2 Use a ladder diagram to identify a simple start/stop station operating a motor starter. |  |
| CTE ELEC.5.2.3 Identify circuit types classified by power source (e.g., common control circuits, transformer control wiring, and separate control wiring). |  |
| CTE ELEC.5.2.4 Identify control devices and their function. |  |
| CTE ELEC.5.2.5 Identify remote‐control circuits and their function. |  |
| CTE ELEC.5.2.6 Identify the components of a magnetic motor starter |  |
| CTE ELEC.5.2.7 Design both two‐wire and three‐wire controls using start/stop stations and other devices such as float switches. |  |
| CTE ELEC.5.2.8 Design a circuit operating a motor starter using two or more start/stop stations. |  |

### YEAR THREE Performance Standard ELEC.5.3 Overcurrent Protection for Control Circuits

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.3.1 Use the NEC to properly protect control circuits to include conductor sizes, overcurrent protection, and control transformers. |  |

### YEAR THREE Performance Standard ELEC.5.4 Indicator Lights, Illuminated Pushbuttons, and Selector Switch Truth Tables

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.4.1 Understand the use of illumination in motor controls. |  |
| CTE ELEC.5.4.2 Interpret symbols used on diagrams. |  |
| CTE ELEC.5.4.3 Read truth tables. |  |
| CTE ELEC.5.4.4 Diagram the use of a selector switch on a three‐wire control for a jogging application. |  |

### YEAR THREE Performance Standard ELEC.5.5 Reversing Motor Controls

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.5.1 Understand the operation of a reversing starter with interlocks. |  |
| CTE ELEC.5.5.2 Understand the operation of a reversing control station. |  |
| CTE ELEC.5.5.3 Understand the operation of a reversing control selector switch. |  |
| CTE ELEC.5.5.4 Apply functional indicator lights to reversing controls. |  |
| CTE ELEC.5.5.5 Understand reversing operations using limit switches. |  |
| CTE ELEC.5.5.6 Understand the operation of reversing a single‐phase motor. |  |

### YEAR THREE Performance Standard ELEC.5.6 Sequencing Control and Master Stop Function

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.6.1 Interpret a diagram showing the sequencing of several motors. |  |
| CTE ELEC.5.6.2 Apply the master stop function to a process using motor controls. |  |

### YEAR THREE Performance Standard ELEC.5.7 Sequencing Control and Master Stop Function

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.7.1 Describe the major characteristics of each type of electrical and electronic diagrams. |  |
| CTE ELEC.5.7.2 Compare the special functions included on ladder diagrams and PLC programming diagrams. |  |
| CTE ELEC.5.7.3 Compare the applications and component arrangements of wiring diagrams and schematic diagrams. |  |

### YEAR THREE Performance Standard ELEC.5.8 Industrial Control System

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.8.1 Compare the common component types and voltage levels of power and control circuits. |  |
| CTE ELEC.5.8.2 Identify the common numbering systems that are used in control circuit diagrams. |  |
| CTE ELEC.5.8.3 Describe the purpose of each logic function and the device arrangements used to form each one. |  |

## **YEAR FOUR STANDARD ELEC.1.0: GENERAL NEC REQUIREMENTS**

### YEAR FOUR Performance Standard ELEC.1.1 Electrical Installation Requirements: Articles 90, 100, and 110

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.1.1.1 Identify scope of the NEC. |  |
| CTE ELEC.1.1.2 Define terms as they apply to the NEC. |  |
| CTE ELEC.1.1.3 Determine the proper termination of conductors. |  |
| CTE ELEC.1.1.4 Determine the kinds of warnings, markings, and identification a given installation requires. |  |
| CTE ELEC.1.1.5 Determine the proper working clearance for any installation. |  |
| CTE ELEC.1.1.6 Determine proper voltage rating. |  |

## YEAR FOUR STANDARD ELEC.2.0: WIRING AND PROTECTION

### YEAR FOUR Performance Standard ELEC.2.1 Use and Identification of Grounded Conductors, Branch Circuits, and Feeders: Articles 200, 210, and 215

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.1.1 Properly identify a grounded conductor. |  |
| CTE ELEC.2.1.2 Properly apply the general provisions of Article 210. |  |
| CTE ELEC.2.1.3 Properly apply the branch circuit’s ratings of Article 210. |  |
| CTE ELEC.2.1.4 Properly install the required outlets of Article 210. |  |
| CTE ELEC.2.1.5 Calculate the minimum size and ampacity of any feeder. |  |

### YEAR FOUR Performance Standard ELEC.2.2 Branch Circuit, Feeder, and Service Calculations: Article 220

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.2.1 Calculate the loads for a single family dwelling. |  |
| CTE ELEC.2.2.2 Calculate the loads for a multifamily dwelling. |  |
| CTE ELEC.2.2.3 Calculate the loads for a commercial or industrial installation. |  |

### YEAR FOUR Performance Standard ELEC.2.3 Outside Branch Circuits and Feeders, Services: Articles 225 and 230

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.3.1 Determine the proper installation for conductors and lighting installed outdoors. |  |
| CTE ELEC.2.3.2 Determine vertical and horizontal clearance of overhead conductors. |  |
| CTE ELEC.2.3.3 Determine proper disconnecting means and installation. |  |
| CTE ELEC.2.3.4 Determine the proper installation and protection of conductors. |  |

### YEAR FOUR Performance Standard ELEC.2.4 Overcurrent Protection: Article 240

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.4.1 Properly size a standard overcurrent device to any conductor. |  |
| CTE ELEC.2.4.2 Properly apply the small conductor rules. |  |
| CTE ELEC.2.4.3 Calculate transformer secondary conductor protection. |  |
| CTE ELEC.2.4.4 Reference requirements for appliance protection. |  |
| CTE ELEC.2.4.5 Calculate tap conductor protection. |  |
| CTE ELEC.2.4.6 Reference protection for motors and air conditioners. |  |

### YEAR FOUR Performance Standard ELEC.2.5 Grounding and Bonding: Article 250

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.5.1 Define the difference between grounding and bonding. |  |
| CTE ELEC.2.5.2 Determine the proper grounding and bonding requirements of any system. |  |
| CTE ELEC.2.5.3 Properly size the main bonding jumper. |  |
| CTE ELEC.2.5.4 Properly size the grounding electrode conductor. |  |
| CTE ELEC.2.5.5 Properly size equipment grounding conductors. |  |
| CTE ELEC.2.5.6 Determine the various types of grounding conductors. |  |
| CTE ELEC.2.5.7 Design a proper grounding electrode system. |  |

### YEAR FOUR Performance Standard ELEC.2.6 Surge Protective Devices (SPDs): Article 285

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.2.6.1 Determine the installation requirements of SPDs. |  |
| CTE ELEC.2.6.2 Discuss the difference between Type 1, Type 2, Type 3, and Type 4 SPDs and their use. |  |

## **YEAR FOUR STANDARD ELEC.3.0: WIRING METHODS AND MATERIALS**

### YEAR FOUR Performance Standard ELEC.3.1 Wiring Methods and Conductors for General Wiring: Articles 300 and 310

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.3.1.1 Determine how to route, splice, protect, and secure conductors and raceways. |  |
| CTE ELEC.3.1.2 Determine the general requirements for conductors such as insulation markings, ampacity ratings, and conductors to use in specific installations. |  |
| CTE ELEC.3.1.3 Properly use the Article 310 tables. |  |
| CTE ELEC.3.1.4 Apply Chapter 9 tables. |  |

### YEAR FOUR Performance Standard ELEC.3.2 Enclosures: Articles 312 and 314

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.3.2.1 Determine the use of any enclosure based on the conditions of use. |  |
| CTE ELEC.3.2.2 Determine the installation requirements for any enclosure. |  |
| CTE ELEC.3.2.3 Properly use boxes and fittings based on internal volume. |  |
| CTE ELEC.3.2.4 Determine the requirements for fill of boxes and fittings. |  |
| CTE ELEC.3.2.5 Properly size pull and junction boxes for No. 4 AWG conductors and larger. |  |

### YEAR FOUR Performance Standard ELEC.3.3 Cables: Articles 320, 330, 334, 338, and 340

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.3.3.1 Determine the installation requirements of Armored Cable. |  |
| CTE ELEC.3.3.2 Determine the installation requirements of Metal‐Clad Cable. |  |
| CTE ELEC.3.3.3 Determine the installation requirements of Nonmetallic‐Sheathed Cable. |  |
| CTE ELEC.3.3.4 Determine the installation requirements of Service‐Entrance Cable. |  |
| CTE ELEC.3.3.5 Determine the installation requirements of Underground Feeder and Branch‐Circuit Cable (Type UF). |  |
| CTE ELEC.3.3.6 Relate temperature concerns, derating, etc. to other appropriate articles in the NEC. |  |

### YEAR FOUR Performance Standard ELEC.3.4 Metal Raceways: Articles 3442, 344, 348, 350, 352, 356, 358, and 362

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.3.4.1 Determine the installation requirements of Intermediate Metal conduit. |  |
| CTE ELEC.3.4.2 Determine the installation requirements of Ridged Metal Conduit. |  |
| CTE ELEC.3.4.3 Determine the installation requirements of Flexible Metal Conduit. |  |
| CTE ELEC.3.4.4 Determine the installation requirements of Liquidtight Flexible Metal Conduit. |  |
| CTE ELEC.3.4.5 Determine the installation requirements of Rigid Polyvinyl Chloride Conduit. |  |
| CTE ELEC.3.4.6 Determine the installation requirements of Liquidtight Flexible Nonmetallic Conduit. |  |
| CTE ELEC.3.4.7 Determine the installation requirements of Electrical Metallic Tubing. |  |
| CTE ELEC.3.4.8 Determine the installation requirements of Electrical Nonmetallic Tubing. |  |
| CTE ELEC.3.4.9 Relate conductor fill, derating, etc. to other appropriate articles in the NEC. |  |

### YEAR FOUR Performance Standard ELEC.3.5 Metal Wireways, Multioutlet Assemblies, Surface Metal Raceways, Cable Trays: Articles 376, 380, 386, and 392

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.3.5.1 Determine the proper installation of a metal wireway. |  |
| CTE ELEC.3.5.2 Calculate the proper conductor fill of a metal wireway. |  |
| CTE ELEC.3.5.3 Calculate the proper size of a metal wireway based on conductor size and conduit entries. |  |
| CTE ELEC.3.5.4 Determine provisions for properly splicing conductors in a metal wireway. |  |
| CTE ELEC.3.5.5 Determine the proper installation of multioutlet assemblies. |  |
| CTE ELEC.3.5.6 Determine the proper installation of surface metal raceways. |  |
| CTE ELEC.3.5.7 Determine the proper installation and use of cable trays. |  |

## **YEAR FOUR STANDARD ELEC.4.0: EQUIPMENT FOR GENERAL USE**

### YEAR FOUR Performance Standard ELEC.4.1 Flexible Cords, Flexible Cables, and Fixture Wires: Articles 400 and 402

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.1.1 Identify requirements, applications, and construction specifications of cords and cables. |  |
| CTE ELEC.4.1.2 Select cords, cables, and fittings listed for specific applications. |  |
| CTE ELEC.4.1.3 Identify requirements and specifications of fixture wires. |  |

### YEAR FOUR Performance Standard ELEC.4.2 Switches, Receptacles, Cord Connectors, and Attachment Plugs: Articles 404 and 406

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.2.1 Determine types and uses of switches. |  |
| CTE ELEC.4.2.2 Determine types and uses of receptacles. |  |

### YEAR FOUR Performance Standard ELEC.4.3 Switchboards, Switchgear, and Panelboards: Article 408

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.3.1 Determine the specific requirements for switchboards, switchgear, and panelboards that control power and lighting circuits. |  |
| CTE ELEC.4.3.2 Properly identify the labeling requirements of each circuit in a panelboard or switchboard. |  |
| CTE ELEC.4.3.3 Determine proper termination of conductors in panelboards and switchboards. |  |

### YEAR FOUR Performance Standard ELEC.4.4 Metal Raceways: Articles 3442, 344, 348, 350, 352, 356, 358, and 362

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.4.1 Determine the general requirements of Article 410. |  |

### YEAR FOUR Performance Standard ELEC.4.5 Metal Wireways, Multioutlet Assemblies, Surface Metal Raceways, Cable Trays: Articles 376, 380, 386, and 392

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.5.1 Determine proper installation of low voltage lighting. |  |

### YEAR FOUR Performance Standard ELEC.4.6 Appliances, Fixed Electric Space Heating Equipment: Articles 422 and 424

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.6.1 Calculate and determine proper branch circuit ratings for any appliance. |  |
| CTE ELEC.4.6.2 Calculate and determine proper overcurrent protection for any appliance. |  |
| CTE ELEC.4.6.3 Determine the requirements for nonmotor appliances. |  |
| CTE ELEC.4.6.4 Determine proper disconnecting means. |  |
| CTE ELEC.4.6.5 Determine requirements for heating installations. |  |

### YEAR FOUR Performance Standard ELEC.4.7 Motors, Motor Circuits, and Controllers; Air-conditioning and Refrigeration Equipment: Articles 430 and 440

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.4.7.1 Determine the proper conductor size for any motor. |  |
| CTE ELEC.4.7.2 Determine the proper overcurrent protection for any motor. |  |
| CTE ELEC.4.7.3 Determine the proper disconnect for any motor. |  |
| CTE ELEC.4.7.4 Determine the proper overload protection for any motor and condition (easy start, hard start, etc.). |  |
| CTE ELEC.4.7.5 Determine the minimum size feeder for a group of motors. |  |
| CTE ELEC.4.7.6 Determine the feeder overcurrent protection. |  |
| CTE ELEC.4.7.7 Determine proper size of circuits and overcurrent devices for air conditioning and refrigeration equipment. |  |

## **YEAR FOUR STANDARD ELEC.5.0: SPECIAL OCCUPANCIES**

### YEAR FOUR Performance Standard ELEC.5.1 Hazardous Locations: Articles 500 through 504

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.1.1 Determine proper wiring of a hazardous location. |  |

### YEAR FOUR Performance Standard ELEC.5.2 Commercial Garages, Motor Fuel Dispensing Facilities: Articles 511 and 514

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.2.1 Define a major repair garage. |  |
| CTE ELEC.5.2.2 Define a minor repair garage. |  |
| CTE ELEC.5.2.3 Classify hazardous areas. |  |
| CTE ELEC.5.2.4 Determine proper wiring methods for a commercial garage of any type. |  |
| CTE ELEC.5.2.5 Define a Motor Fuel Dispensing Facility. |  |
| CTE ELEC.5.2.6 Determine proper wiring methods for Motor Fuel Dispensing Facilities. |  |

### YEAR FOUR Performance Standard ELEC.5.3 Health Care Facilities: Article 517

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.3.1 Define health care facility types. |  |
| CTE ELEC.5.3.2 Define General Care Areas and Critical Care Areas. |  |
| CTE ELEC.5.3.3 Discuss Essential Electrical Systems. |  |
| CTE ELEC.5.3.4 Determine proper wiring and grounding for a health care facility. |  |

### YEAR FOUR Performance Standard ELEC.5.4 Assembly Occupancies, Carnivals, Fairs, and Similar Events: Articles 518 through 525

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.4.1 Discuss the proper wiring methods for places of assembly. |  |
| CTE ELEC.5.4.2 Discuss the proper wiring of carnivals, fairs, and similar events. |  |

### YEAR FOUR Performance Standard ELEC.5.5 Agricultural Buildings: Article 547

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.5.1 Determine the proper wiring method for any agricultural building. |  |
| CTE ELEC.5.5.2 Determine proper grounding for any agricultural building. |  |

### YEAR FOUR Performance Standard ELEC.5.6 Marinas and Boatyards: Article 555

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.6.1 Determine marina requirements using the NEC. |  |

### YEAR FOUR Performance Standard ELEC.5.7 Temporary Installations: Article 590

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.5.7.1 Determine the requirements for temporary installations. |  |

## **YEAR FOUR STANDARD ELEC.6.0: SPECIAL EQUIPMENT**

### YEAR FOUR Performance Standard ELEC.6.1 Electric Signs and Outline Lighting, Manufactured Wiring Systems: Articles 600 and 604

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.6.1.1 Determine proper installation and requirements of electric signs and associated lighting. |  |
| CTE ELEC.6.1.2 Determine proper installation of manufactured wiring systems. |  |

### YEAR FOUR Performance Standard ELEC.6.2 Cranes and Hoists: Article 610

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.6.2.1 Determine proper wiring of cranes and hoists. |  |

### YEAR FOUR Performance Standard ELEC.6.3 Elevators, Escalators, and Moving Walks: Article 620

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.6.3.1 Determine proper installation requirements of elevators, escalators, and moving walks. |  |

### YEAR FOUR Performance Standard ELEC.6.4 Audio Signal Processing, Amplification, Reproduction Equipment: Article 640

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.6.4.1 Determine proper wiring methods for audio equipment. |  |

### YEAR FOUR Performance Standard ELEC.6.5 Information Technology Equipment: Article 645

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.6.5.1 Define an IT room. |  |
| CTE ELEC.6.5.2 Determine proper installation of wiring in IT rooms. |  |

### YEAR FOUR Performance Standard ELEC.6.6 Swimming Pools, Spas, Hot Tubs, Fountains, and Similar Locations: Article 680

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.6.6.1 Determine proper electrical installations for swimming pools. |  |
| CTE ELEC.6.6.2 Determine proper electrical installations for spas and hot tubs. |  |
| CTE ELEC.6.6.3 Determine proper electrical installations for fountains. |  |

## **YEAR FOUR STANDARD ELEC.7.0: SPECIAL CONDITIONS**

### YEAR FOUR Performance Standard ELEC.7.1 Emergency Standby Power Systems, Legally Required Power Systems, Optional Standby Power Systems: Articles 700 through 702

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.7.1.1 Determine the proper installation of standby power systems. |  |
| CTE ELEC.7.1.2 Determine the difference between emergency standby, legally required standby, and optional standby power systems. |  |

### YEAR FOUR Performance Standard ELEC.7.2 Remote-control, Signaling, and Power-limited Circuits: Article 725

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.7.2.1 Define circuit classes. |  |
| CTE ELEC.7.2.2 Determine proper installation and requirements of different circuit classes. |  |

**YEAR FOUR Performance Standard ELEC.7.3 Fire Alarm Systems: Article 760**

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.7.3.1 Define nonpower‐limited fire alarm circuits. |  |
| CTE ELEC.7.3.2 Define power‐limited fire alarm circuits. |  |
| CTE ELEC.7.3.3 Determine the proper installation of fire alarm wiring using the NEC. |  |
| CTE ELEC.7.3.4 Determine where the use of GFCI and AFCI are restricted. |  |

## **YEAR FOUR STANDARD ELEC.8.0: COMMUNICATION SYSTEMS**

### YEAR FOUR Performance Standard ELEC.8.1 Optical Fiber Cables and Raceways; Communications Systems: Articles 770, and 800 through 820

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE ELEC.8.1.1 Determine proper installation of optical fiber cables. |  |
| CTE ELEC.8.1.2 Determine proper grounding of communications wiring and equipment. |  |
| CTE ELEC.8.1.3 Determine proper installations of communication wiring. |  |

# Indicators of quality Rubric:

Standards aligned and Integrated Curriculum:

| Standards | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| 1. The curriculum is based on industry-validated technical standards and competencies. |  |
| 1. The curriculum is aligned with relevant content and standards for core subjects, such as reading, math and science, including federal, state and/or local standards, as appropriate. |  |
| 1. The curriculum incorporates employability skill standards that help students succeed in the workplace, such as problem solving, critical thinking, teamwork, communications and workplace etiquette. |  |
| 1. The curriculum allows for student application of integrated knowledge and skills in authentic scenarios. |  |
| 1. Materials used reflect current workplace, industry and/or occupational practices and requirements. |  |

Access and Equity:

| Standards | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| 1. Materials are provided in a way that ensures all students have the opportunity to achieve success in the program of study, including by meeting Title IX, Americans with Disabilities Act and other accessibility requirements. |  |
| 1. Materials and assessments are free from bias, inclusive and non-discriminatory, and offered in a way that ensures all students have the opportunity to achieve success in the program of study. |  |
| 1. Contains guidance to support differentiated and culturally responsive (i.e., purposefully represents diverse cultures, linguistic backgrounds, learning styles and interests) instruction in the classroom so that every student’s need are addressed by including:    1. Suggestions for how to promote equitable instruction by making connections to culture, home, neighborhood, and community as appropriate.    2. Appropriate scaffolding, interventions, and supports, including integrated and appropriate reading, writing, listening, and speaking alternatives (e.g., translations, picture support, graphic organizers) that neither sacrifice content nor avoid language development for English language learners, special needs, or below grade level readers.    3. Digital and print resources that provide various levels of readability.    4. Modifications and extensions for all students, including those performing above their grade level, to deepen understanding of the content.    5. Materials in multiple language formats. |  |

Student Focus:

| Standards | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| 1. The material supports the sequential and cumulative development of foundational skills and progresses in specificity to build students’ depth of knowledge and skills. Those skills are necessary for a student’s independent comprehension of grade-level complex texts and mastery of tasks called for by the standards. |  |
| 1. Content and standards within the program of study are non-duplicative and vertically aligned to prepare students to transition seamlessly to the next level of education. |  |
| 1. The material provides many and varied opportunities for students to work with each standard within the grade level. |  |
| 1. The material cross-refers and integrates other content areas. |  |
| 1. The material has a balance of text types and lengths that encourage close, in-depth reading and rereading, analysis, comparison, and synthesis of texts. |  |
| 1. The material includes sufficient supplementary activities or assignments that are appropriately integrated into the text. |  |
| 1. The material has activities and assignments that develop problem-solving skills and foster synthesis and inquiry at both an individual and group level. |  |
| 1. The material has activities and assignments that reflect varied learning styles of students. |  |
| 1. The material includes appropriate instructional strategies. |  |
| 1. Project-based learning and related instructional approaches, such as problem-based, inquiry-based and challenge-based learning, are fully integrated into the material. |  |

Pedagogical Approach:

| Standards | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| 1. Provides guidance for teachers throughout for how learning experiences build on each other to support students in developing a deep understanding of the content. |  |
| 1. Provides scaffolded supports for teachers to facilitate learning of the content so that students are increasingly responsible for making sense of the content. |  |
| 1. The material provides opportunities for supporting English language learners to regularly and actively participate with grade-level text. |  |
| 1. The material gives clear and concise instruction to teachers and students. It is easy to navigate and understand. |  |
| 1. Includes appropriate academic and content-specific vocabulary in the context of the learning experience that is accessible, introduced, reinforced, reviewed, and augmented with visual representations when appropriate. |  |
| 1. Allows teachers to access, revise, and print form digital resources (e.g., readings, labs, assessments, rubrics). |  |
| 1. Uses varied modes (selected, constructed, project-based, extended response, and performance tasks) of instruction-embedded pre-, formative, summative, peer, and, self-assessment measures of learning. |  |
| 1. Includes editable and aligned rubrics, scoring guidelines, and exemplars that provide guidance for assessing student performance and to support teachers in planning instruction and providing ongoing feedback to students. |  |
| 1. Provides multiple opportunities for students to demonstrate and receive feedback on performance of practices connected with their understanding of concepts. |  |

Presentation and Design:

| Standards | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| 1. The material has an aesthetically appealing appearance. |  |
| 1. Digital and print materials are consistently formatted, visually focused, and uncluttered for efficient use. |  |
| 1. The material has a reasonable and appropriate balance between text and illustration. The material has grade-appropriate font size. |  |
| 1. The illustrations clearly cross-reference the text, are directly relevant to the content (not simply decorative), and promote thinking, discussion, and problem solving. |  |
| 1. Non-text content (performance clips, images, maps, globes, graphs, pictures, charts, databases, and models) are accurate and well integrated into the text. |  |

Technology:

| Standards | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| 1. Technology and digital media support, extend, and enhance learning experiences. |  |
| 1. The material has “platform neutral” technology (i.e., cloud based) and availability for networking. |  |
| 1. The material has a user-friendly and interactive interface allowing the user to control (shift among activities). |  |

For Questions Contact

Content & Curriculum

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1. [Idaho T&I Electrical Apprenticeship Year 1 Program Standards](https://cte.idaho.gov/wp-content/uploads/2018/02/Electrical-Apprenticeship-Program-Standards-Year-1..pdf) [↑](#footnote-ref-1)
2. [Idaho T&I Electrical Apprenticeship Year 2 Program Standards](https://cte.idaho.gov/wp-content/uploads/2018/02/Electrical-Apprenticeship-Program-Standards-Year-2..pdf) [↑](#footnote-ref-2)
3. [Idaho T&I Electrical Apprenticeship Year 3 Program Standards](https://cte.idaho.gov/wp-content/uploads/2016/01/Final-Electrical-Apprenticeship-Program-Standards-Year-3.pdf) [↑](#footnote-ref-3)
4. [Idaho T&I Electrical Apprenticeship Year 3 Program Standards](https://cte.idaho.gov/wp-content/uploads/2016/01/Final-Electrical-Apprenticeship-Program-Standards-Year-3.pdf) [↑](#footnote-ref-4)