

**COMMERCIAL/INDUSTRIAL  
ELECTRICIAN'S ASSISTANT  
SKILLS STANDARDS**

**OD33201**



*ALIGNED WITH  
OKLAHOMA  
CONSTRUCTION  
INDUSTRIES  
BOARD*

## ***COMPETENCY-BASED EDUCATION: OKLAHOMA'S RECIPE FOR SUCCESS***

### ***BY THE INDUSTRY FOR THE INDUSTRY***

Oklahoma's *CareerTech* system of competency-based education uses industry professionals and certification standards to identify the knowledge and abilities needed to master an occupation. This industry input provides the foundation for development of instructional materials that help prepare the comprehensively trained, highly skilled employees demanded by our workplace partners.

### ***TOOLS FOR SUCCESS***

*CareerTech* relies on three basic instructional components to deliver competency-based instruction: skills standards, curriculum materials, and competency assessments.

**Skills standards** provide the foundation for competency-based instruction in Oklahoma's *CareerTech* system. The skills standards outline the knowledge, skills, and abilities needed to perform related jobs within an industry. Skills standards are aligned with national skills standards; therefore, a student trained to the skills standards possesses technical skills that make him/her employable in both state and national job markets.

**Curriculum materials** contain information and activities that teach students the knowledge and skills outlined in the skills standards. In addition to complementing classroom instruction, curriculum resources provide supplemental activities to enhance learning and provide hands-on training experiences.

**Competency Assessments** test the student over material outlined in the skills standards and taught using the curriculum materials. When used with classroom performance evaluations, written competency assessments provide a means of measuring occupational readiness.

Although each of these components satisfy a unique purpose in competency-based education, they work together to reinforce the skills and abilities students need to gain employment and succeed on the job.

### ***MEASURING SUCCESS***

Written competency assessments are used to evaluate student performance. Results reports communicate competency assessment scores to students and provide a breakdown of assessment results by duty area. The results breakdown shows how well the student has mastered skills needed to perform major job functions and identifies areas of job responsibility that may require additional instruction and/or training.

Group analysis of student results also provides feedback to instructors seeking to improve the effectiveness of career and technology training. Performance patterns in individual duties indicate opportunities to evaluate training methods and customize instruction.

### ***TRUE TO OUR PURPOSE***

"Helping Oklahomans succeed in the workplace" defines the mission of Oklahoma *CareerTech* and its competency-based system of instruction. Skills standards, curriculum, and assessments that identify and reinforce industry expectations provide accountability for programs and assure *CareerTech*'s continued role in preparing skilled workers for a global job market

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## ELECTRICAL TRADES DEFINITIONS

**ELECTRICIAN**—The electrician working in the residential, commercial, and industrial areas plans layout, installs and repairs wiring, electrical fixtures, apparatus, and control equipment. The various tasks for the all encompassing electrician include planning new or modified installations to minimize waste of materials, providing access for future maintenance, and avoiding unsightly, hazardous, and unreliable wiring consistent with specifications and state and local electrical codes. Additional tasks include preparing sketches showing location of wiring and equipment; following diagrams and blueprints to ensure that concealed wiring is installed before completion of future walls, ceilings, and flooring; measuring, cutting, bending, threading, assembling, and installing electrical conduit using tools such as a hacksaw, pipe threader, and conduit bender; pulling wiring through conduit; splicing wires by stripping insulation from terminal leads using knife or pliers, twisting or soldering wires together, and applying tape or terminal caps; connecting wiring to lighting fixtures and power equipment using hand tools; installing control and distribution apparatus such as switches, relays, and circuit-breaker panels, fastening in place with screws or bolts using hand and power tools; connecting power cables to equipment such as electric range or motor and installing grounding leads; testing continuity of circuit to ensure electrical compatibility and safety of components using testing instruments such as ohmmeter, battery and buzzer, and oscilloscope; and observing functioning of installed equipment or system to detect hazards and need for adjustments, relocation, or replacements. The electrician is required to hold a license and may also be required to repair faulty equipment and systems, and cut and weld steel structural members using flame-cutting and welding equipment.

\***ELECTRICAL APPRENTICE**—means any person sixteen (16) years of age or older whose principal occupation is learning of and assisting in the installation of electrical work under the direct supervision of a licensed journeyman electrician or electrical contractor. Must be registered as an apprentice.

\***JOURNEYMAN ELECTRICIAN**—means any person other than an electrical contractor who engages in the actual installation, alteration, repair or renovation of electrical facilities unless specifically exempted by the provisions of the Electrical License Act.

\***ELECTRICAL CONTRACTOR**--means any person skilled in the planning, superintending and practical installation of electrical facilities who is familiar with the laws, rules and regulations governing such work. Electrical contractor also means any individual, firm, partnership, corporation or business performing skills of an electrical contractor or an electrician or the business of contracting, or furnishing labor or labor and materials for the installation, repair, maintenance or renovation of electrical facilities according to the provisions of the Electrical License Act.

\***ELECTRICAL FACILITIES**--means all wiring, fixtures, appurtenances, and appliances for, and in connection with, a supply of electricity within or adjacent to any building, structure or conveyance on the premises but not including the connection with a power supply meter or other power supply source.

\***CATEGORY**--means the classification by which licenses and electrical work may be limited. Such categories shall include but shall not be limited to installation, maintenance, repair, alteration, residential, oil fields, and commercial

\***VARIANCE AND APPEALS BOARD**--means the Oklahoma State Electrical Installation Code Variance and Appeals Board

*\*as defined by the Electrical Licensing Act*

**COMMERCIAL/INDUSTRIAL ELECTRICIAN'S ASSISTANT  
SKILLS STANDARDS  
Frequency and Criticality Ratings**

- Duty A: \*Apply Sound Business Practices
- Duty B: \*Comply with Provisions of Workers Compensation
- Duty C: \*Comply with Lien Laws
- Duty D: \*Demonstrate Knowledge of "Electrical Licensing Act"
- Duty E: Plan and Organize Work
- Duty F: Perform Activities Related to Basic Circuits
- Duty G: Perform Activities Related to Alternating Current Circuits
- Duty H: Demonstrate Knowledge of NEC Introduction, Definitions, and Requirements for Electrical Installations
- Duty I: Perform Calculations
- Duty J: Install Services
- Duty K: Install Switch and Outlet Boxes
- Duty L: Rough In Circuits
- Duty M: Install Electrical Field Wiring for Environmental Control Systems
- Duty N: Trim Out (Finish) Electrical Devices and Appliances
- Duty O: Maintain and Repair Existing Wiring Systems
- Duty P: Install and Maintain Special Systems
- Duty Q: Install Transformers
- Duty R: Install AC and DC Rotating Equipment
- Duty S: Construct, Install and Maintain Electrical Control Systems and Devices
- Duty T: Install Low-Voltage and Data Communications Systems
- Duty U: Demonstrate Safety Skills

\*These job duties and tasks pertain only to the licensed Electrical Contractor. These are included for informational purposes and intended to assist those students who will ultimately seek licensure with the State of Oklahoma. This information is not evaluated on the written competency exams.

It is intended that the occupation included in this publication will have expertise greater than the typical Electrical Apprentice, as registered by the State of Oklahoma, and approaching that of a Journeyman Electrician, with the main difference being the level of practical experience attained.

Unless otherwise noted, all installations are to be made per manufacturers' instructions. All materials are to be labeled and listed for the purpose.

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**Frequency:** represents how often the task is performed on the job. Frequency rating scales vary for different occupations. The rating scale used in this publication is presented below:

- 1 = less than once a week
- 2 = at least once a week
- 3 = once or more a day

**Criticality:** denotes the level of consequence associated with performing a task incorrectly. The rating scale used in this publication is presented below:

- 1 = slight
  - 2 = moderate
  - 3 = extreme
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**DUTY A: Apply Sound Business Practices**

<b>CODE</b>	<b>TASK</b>
	Taxes
A.01	Calculate Social Security tax <ul style="list-style-type: none"><li>• Tax rate</li><li>• Wage base</li></ul>
A.02	Calculate Medicare Tax <ul style="list-style-type: none"><li>• Tax rate</li><li>• Wage base</li></ul>
A.03	Calculate Federal Unemployment (FUTA) tax <ul style="list-style-type: none"><li>• Tax rate</li><li>• Wage base</li></ul>
A.04	Prepare/distribute W-2 forms <ul style="list-style-type: none"><li>• Time schedule</li></ul>
A.05	Deposit withholdings <ul style="list-style-type: none"><li>• Method</li><li>• Schedule</li><li>• Location</li></ul>
	Business Practices
A.06	Prepare estimates <ul style="list-style-type: none"><li>• Materials</li><li>• Labor</li><li>• Direct job expenses</li></ul>
A.07	Maintain inventory
A.08	Order supplies <ul style="list-style-type: none"><li>• Determine markup</li></ul>
A.09	Calculate receivables/invoices <ul style="list-style-type: none"><li>• Discounts</li></ul>
A.10	Pay bills <ul style="list-style-type: none"><li>• Discounts</li><li>• Insurance</li><li>• Liabilities</li></ul>
A.11	Maintain cash flow
A.12	Determine profits
A.13	Determine overhead expenses <ul style="list-style-type: none"><li>• Definition</li><li>• Calculation</li></ul>
A.14	Determine company assets
A.15	Comply with Employment Security Act requirements
A.16	Catalog technical publications

**DUTY B: Comply with Provisions of Workers Compensation**

CODE	TASK
B.01	Select proper forms <ul style="list-style-type: none"> <li>• Notice and Instructions to Employers and Employees</li> <li>• Application for Permission to Carry Its Own Risk Without Insurance (can only be filled out by an active Oklahoma electrical contractor)</li> <li>• Employer's First Notice of Injury</li> <li>• Employee's First Notice of Accidental Injury and Claim for Compensation</li> <li>• Claimant's First Notice of Death and Claim for Compensation</li> <li>• Employee's First Notice of Occupational Disease and Claim for Compensation</li> <li>• Employee's Claim for Benefits from the Special Indemnity Fund</li> <li>• Attending Physician's Report and Notice of Treatment</li> <li>• Employer's Insurance Carrier's or Claims Servicing Company's Initial Report of Payment of Compensation</li> <li>• Acknowledgment by Employee of Receipt of Compensation Payment</li> <li>• Motion to Set for Trial</li> <li>• Answer and Pretrial Stipulation Offered by Respondent</li> <li>• Response to Request for Payment of Charges for Medical or Rehabilitation Services</li> <li>• Motion to Terminate Temporary Compensation</li> <li>• Request for Pre-hearing Conference</li> <li>• Agreement Between Employer and Employee as to Fact with Relation to an Injury and Payment for Compensation</li> <li>• Request for Administrative Review of Medical Charges</li> <li>• Request for Payment of Charges for Medical or Rehabilitative Services</li> <li>• Notice of Appeal of Administration Order</li> <li>• Proof of Loss in Death Claim</li> </ul>
B.02	Initiate a claim <ul style="list-style-type: none"> <li>• &lt;10% owner of firm</li> </ul>
B.03	Initiate a claim against the Special Indemnity Fund
B.04	Initiate temporary compensation and medical treatment

**DUTY C: Comply with Lien Laws**

CODE	TASK
C.01	File "Mechanic's and Materials Liens" <ul style="list-style-type: none"> <li>• 5 w's (who, what, where, why, when)</li> <li>• Time frame to file</li> <li>• Items not covered (PaS.142.3)</li> <li>• Falsified statement = felony</li> <li>• Subcontractors</li> <li>• Rented/leased equipment</li> </ul>

C.02	<p>Enforce lien</p> <ul style="list-style-type: none"> <li>• Required statement/signature</li> <li>• Lien waivers</li> <li>• Owner's right to withhold payment</li> </ul>
C.03	<p>Submit "Notice-filing of Lien Statement"</p> <ul style="list-style-type: none"> <li>• Charge/cost</li> <li>• Post notice on occupied or unoccupied property</li> </ul>
C.04	<p>Discharge of lien</p> <ul style="list-style-type: none"> <li>• Cash for lien (3-day written notice)</li> <li>• Bond for other costs (attorney fees, court costs, and interest)</li> <li>• 5-day delay for possible bond increase</li> </ul>

**DUTY D: Demonstrate Knowledge of the 'Electrical Licensing Act'**

CODE	TASK
D.01	<p>Describe make-up of Committee of Electrical Examiners</p> <ul style="list-style-type: none"> <li>• 6 voting members from trade</li> <li>• 1 non-voting member – OSDH (Chief Electrical Inspector)</li> </ul>
D.02	<p>Describe responsibilities of Committee of Electrical Examiners</p> <ul style="list-style-type: none"> <li>• Advise commissioner on rules, regulations, and standards</li> <li>• Administer examinations of applicants for electrical journeyman and contractor (may authorize the Department to conduct tests)</li> </ul>
D.03	<p>Comply with licensing examination requirements</p> <ul style="list-style-type: none"> <li>• Administered twice yearly, or as necessary</li> <li>• Must wait a minimum of 30 days to retake exam (registration required)</li> <li>• Retake after subsequent failure in another 90 days</li> </ul>
D.04	<p>Obtain appropriate license (contractor or journeyman)</p> <ul style="list-style-type: none"> <li>• Must be an active electrical contractor to engage in business</li> <li>• Submit required application</li> <li>• Pay applicable fee</li> <li>• Pass applicable examination</li> <li>• Non-transferable</li> <li>• Expires June 30</li> <li>• Maintain bond (active contractor) <ul style="list-style-type: none"> <li>• Bond will be forfeited in the event of willful non-performance of contractual obligations</li> </ul> </li> <li>• Maintain insurance (active contractor)</li> <li>• Meet experience requirements</li> </ul>
D.05	<p>Renew applicable license (contractor or journeyman)</p> <ul style="list-style-type: none"> <li>• Pay applicable fee</li> <li>• Pay applicable late fee (after one month) – exception: military service</li> <li>• Meet continuing education requirement</li> <li>• License lapses if not renewed in one year (new application required)</li> </ul>
D.06	<p>Demonstrate knowledge of electrical apprentice provisions and requirements</p>

	<ul style="list-style-type: none"> <li>• Age: 16 years or more</li> <li>• Enrolled in <u>approved</u> training course, or has arranged employment with an electrical contractor</li> <li>• Fee required</li> <li>• Shall be registered with the State Department of Health</li> <li>• Must have direct on-the-job supervision by contractor or journeyman</li> <li>• No more than two (2) apprentices working under the supervision of each journeyman or contractor</li> <li>• Must be employed by the same firm as supervising electrical journeyman or contractor</li> </ul>
D.07	Demonstrate knowledge of the penalties for violations
D.08	Demonstrate an understanding of the relationship between state and local/city requirements
D.09	Demonstrate knowledge of journeyman electrical requirements/restrictions <ul style="list-style-type: none"> <li>• Must be licensed and employed by active licensed electrical contractor</li> <li>• Shall not contract to furnish labor, or labor and materials</li> <li>• Age/experience</li> </ul>
D.10	Demonstrate knowledge of electrical contractor requirements/restrictions <ul style="list-style-type: none"> <li>• Notice of address change within 30 days</li> <li>• Inactive contractor can work as a journeyman</li> <li>• May register with only one electrical firm</li> <li>• Vehicle markings</li> <li>• Continuous bond (30-day cancellation notice) of \$5,000</li> <li>• Certificate of insurance (\$50,000 liability) to State Health Department</li> <li>• Completed operation and independent contractor coverage</li> </ul>
D.11	Demonstrate knowledge of classification of electrical license <ul style="list-style-type: none"> <li>• Unlimited contractor</li> <li>• Unlimited journeyman</li> <li>• Residential contractor</li> <li>• Residential journeyman</li> </ul>
D.12	Demonstrate knowledge of provisions for plan review, code variance, applications and fees, and code appeals
D.13	Demonstrate knowledge of the fee and fine schedule

**DUTY E: Plan and Organize Work**

CODE	TASK	F/C
E.01	Plan a sequence of work operations <ul style="list-style-type: none"> <li>• Review plans and specifications</li> </ul>	1/2
E.02	Inventory equipment and supplies	1/2
E.03	Compile a list of motor nameplate data	1/2
E.04	Update schematic print files for machinery	1/2
E.05	Plan a shutdown procedure for a given area	1/2
E.06	Set up a trouble log on maintenance or equipment	1/2
E.07	Compile list of materials from wiring blueprints	1/2

E.08	Coordinate work with public utilities	1/2
E.09	Draw control panel diagrams	1/2
E.10	Draw external power diagrams	1/2
E.11	Draw schematic diagrams from pre-wired circuits	1/2
E.12	Draw an as-built electrical plan	1/2

**DUTY F: Perform Activities Related to Basic Circuits**

CODE	TASK	F/C
F.01	Construct/analyze/install series circuits	3/2
F.02	Troubleshoot series circuit	3/2
F.03	Draw series circuit and calculate circuit values	3/2
F.04	Construct/analyze/install parallel circuits	3/2
F.05	Troubleshoot parallel circuits	3/2
F.06	Draw parallel circuit and calculate circuit values	3/2
F.07	Construct/analyze/install series-parallel circuits	3/2
F.08	Troubleshoot series-parallel circuits	3/2
F.09	Draw series-parallel circuits and calculate circuit values	3/2
F.10	Set up and operate for basic circuits <ul style="list-style-type: none"> <li>• volt amp meter</li> <li>• ohmmeter</li> <li>• voltage tester</li> </ul>	3/2

**DUTY G: Perform Activities Related to Alternating Current Circuits**

CODE	TASK	F/C
G.01	Identify alternating current sources	3/3
G.02	Analyze and apply principles of transformers to AC circuits <ul style="list-style-type: none"> <li>• buck and boost</li> <li>• low voltage</li> </ul>	3/3
G.03	Install single phase circuits	3/3
G.04	Troubleshoot single phase circuits	3/3
G.05	Construct/analyze/install polyphase circuits	3/3
G.06	Troubleshoot polyphase circuits	3/3
G.07	Remove/replace capacitors in an AC circuit	3/3
G.08	Test capacitors in an AC circuit	3/3
G.09	Install power transformers	3/3
G.10	Troubleshoot power transformers	3/3
G.11	Install control transformers	3/3
G.12	Troubleshoot control transformers	3/3
G.13	Make proper connections on dual voltage motors	3/3
G.14	Make proper connections on dual voltage generators	

**DUTY H: Demonstrate Knowledge of NEC Introduction, Definitions, And Requirements For Electrical Installations**

CODE	TASK	F/C
H.01	Demonstrate knowledge of Article 90 (Introduction)	3/3
H.02	Demonstrate knowledge of Article 100 (Definitions)	3/3
H.03	Demonstrate knowledge of Article 110 (Requirements for Electrical Installations)	3/3
H.04	Demonstrate knowledge of Article 210 (Branch Circuit Requirements)	3/3
H.05	Demonstrate knowledge of Article 230 (Service Point Locations)	3/3

**DUTY I: Perform Calculations**

CODE	TASK	F/C
I.01	Calculate and balance the total load per phase	2/3
I.02	Calculate the grounding electrode system and bonding requirements <ul style="list-style-type: none"> <li>• size</li> <li>• materials</li> </ul>	2/3
I.03	Calculate individual circuits	2/3
I.04	Calculate the load in volt-amperes and the load current in amperes	2/3
I.05	Calculate service size <ul style="list-style-type: none"> <li>• branch circuit</li> <li>• feeder circuit</li> <li>• service circuit</li> </ul>	2/3
I.06	Determine the number of convenience and appliance outlets per circuit	2/3
I.07	Perform transformer and motor calculations	2/3
I.08	Calculate voltage drop	2/3
I.09	Calculate conductors <ul style="list-style-type: none"> <li>• de-rating</li> <li>• correction factors</li> </ul>	2/3
I.10	Calculate size of raceways and enclosures	2/3
I.11	Calculate over-current protection	2/3
I.12	Perform calculations using Ohm's Law	2/3

**DUTY J: Install Services**

CODE	TASK	F/C
J.01	Ground service equipment <ul style="list-style-type: none"> <li>• grounding electrode systems</li> <li>• bonding</li> </ul>	1/3
J.02	Size and install service conductors	1/3
J.03	Install mast-type service	1/3
J.04	Install main service disconnects (master switches)	1/3
J.05	Install circuit breakers in panels	1/3
J.06	Install and connect mobile home/office service	1/3
J.07	Install service panels (distribution panel boards)	1/3
J.08	Install temporary service	1/3
J.09	Install underground service	1/3

J.10	Install metering equipment	1/3
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**DUTY K: Install Switch and Outlet Boxes**

CODE	TASK	F/C
K.01	Install and size boxes <ul style="list-style-type: none"> <li>• new construction</li> <li>• existing construction</li> <li>• hazardous locations</li> </ul>	3/1
K.02	Install recessed fixture housings in ceilings	3/1
K.03	Install bar-hanger mounted box	3/1
K.04	Install flush mount junction box	3/1
K.05	Install flush mount switch and outlet box in <ul style="list-style-type: none"> <li>• drywall</li> <li>• lathe and plaster wall</li> <li>• paneled wall</li> <li>• masonry wall</li> </ul>	3/1
K.06	Install gangable boxes	3/1
K.07	Install octagon outlet box	3/1
K.08	Install surface mount junction box	3/1
K.09	Install subsurface enclosures	3/1
K.10	Install raceway supported enclosures (314.23)	3/1

**DUTY L: Rough-in Circuits**

CODE	TASK	F/C
L.01	Lay out electrical systems <ul style="list-style-type: none"> <li>• use material and devices labeled and listed for the purpose</li> <li>• follow all grounding and bonding requirements</li> </ul>	2/3
L.02	Rough-in feeders and circuits using a cable system <ul style="list-style-type: none"> <li>• new construction</li> <li>• existing construction</li> </ul>	2/3
L.03	Rough-in and properly secure circuits in conduits and other raceways <ul style="list-style-type: none"> <li>• new construction</li> <li>• existing construction</li> </ul>	2/3
L.04	Rough-in and properly secure cables or conduits for branch circuits	2/3
L.05	Connect circuits to circuit breaker panels	2/3
L.06	Rough-in circuits to outlet boxes	2/3
L.07	Rough-in cables between existing boxes and newly installed boxes	2/3
L.08	Rough-in a circuit for an outlet controlled with <ul style="list-style-type: none"> <li>• three-way switches</li> <li>• three-way switches and four-way switches</li> <li>• feed to the device outlet box</li> <li>• feed to the device</li> <li>• feed to the three-way switch</li> </ul>	2/3
L.09	Rough-in low-voltage circuits <ul style="list-style-type: none"> <li>• door chime system</li> <li>• intercom system</li> </ul>	2/3
L.10	Rough-in cables for general purpose branch circuits	2/3

	<ul style="list-style-type: none"> <li>• single pole switch</li> <li>• three-way switch</li> <li>• four-way switch</li> <li>• receptacle outlet</li> <li>• lighting outlet</li> </ul>	
L.11	Make splices using mechanical-type connectors <ul style="list-style-type: none"> <li>• split bolt connectors</li> <li>• wire nuts</li> </ul>	2/3
L.12	Make joints using crimp type connectors (splices)	2/3
L.13	Make terminations	2/3
L.14	Rough-in branch circuit wires to panels	2/3
L.15	Install panels and subpanels	2/3
L.16	Run feeder cables from main service panels to subpanels	2/3
L.17	Rough-in weatherproof outlet boxes and covers	2/3
L.19	Rough-in electrical environmental control components	2/3
L.20	Install conduits, cables, raceways, and equipment <ul style="list-style-type: none"> <li>• indoor</li> <li>• outdoor</li> <li>• underground</li> <li>• non-liquid tight flexible metal</li> <li>• liquid-tight flexible metal</li> <li>• rigid</li> <li>• plastic</li> <li>• compensate for expansion</li> <li>• multi-conduit layout</li> <li>• thin wall (EMT)</li> <li>• direct burial</li> <li>• multi-conductor</li> <li>• wet locations</li> <li>• dry locations</li> <li>• submerged locations</li> </ul>	2/3
L.21	Install receptacle circuits <ul style="list-style-type: none"> <li>• single phase</li> <li>• three phase</li> </ul>	2/3
L.22	Rough-in thermostat wiring <ul style="list-style-type: none"> <li>• low voltage</li> <li>• temperature control</li> </ul>	2/3
L.23	Demonstrate knowledge of outside branch circuits and feeders	2/3

**DUTY M: Install Electrical Field Wiring for Environmental Control Systems**

CODE	TASK	F/C
M.01	Install/connect baseboard heating systems	1/2
M.02	Install/connect wall heaters	1/2
M.03	Install/connect ceiling heat cables	1/2
M.04	Connect central electric heat	1/2
M.05	Install individual space heaters	1/2
M.06	Connect thermostats <ul style="list-style-type: none"> <li>• line voltage</li> <li>• low-voltage</li> </ul>	1/2

M.07	Connect furnace motors	1/2
M.08	Connect gas/oil fired heating units	1/2
M.09	Connect wiring for boiler control systems	1/2
M.10	Install/connect for ventilation systems	1/2
M.11	Install/connect for air conditioning systems	1/2
M.12	Install/connect all associated field wiring for environmental controls	1/2

**DUTY N: Trim Out (Finish) Electrical Devices and Appliances**

CODE	TASK	F/C
N.01	Install/connect all lighting fixtures and circuits	3/2
N.02	Install/connect paddle fans	3/2
N.03	Install/connect a photoelectric control on a light	3/2
N.04	Install/connect heat-a-vent lights	3/2
N.05	Install/connect post lights	3/2
N.06	Determine the proper location for and install/connect emergency lighting systems	3/2
N.07	Install/connect receptacles	3/2
N.08	Install/connect switches	3/2
N.09	Install/connect time switches <ul style="list-style-type: none"> <li>• delayed action</li> </ul>	3/2
N.10	Install/connect appliances	3/2
N.11	Connect sump and well pump motors	3/2
N.12	Install/connect panels	3/2
N.13	Install/connect de-icing equipment	3/2
N.14	Install/connect low-voltage systems	3/2
N.15	Install/connect ground fault interrupting devices	3/2
N.16	Connect water heaters	3/2
N.17	Connect humidity control devices	3/2
N.18	Install/connect circuits for hydromassage tubs	3/2
N.19	Install/connect pilot indicating lights	3/2
N.20	Determine the proper location for and install smoke and CO detectors	3/2
N.21	Install/connect lighting dimmer systems	3/2

**DUTY O: Maintain and Repair Existing Wiring Systems**

CODE	TASK	F/C
O.01	Troubleshoot/repair/replace HVAC system controls	1/2
O.02	Troubleshoot/repair/replace relays and timers	1/2
O.03	Troubleshoot/repair/replace lighting fixtures <ul style="list-style-type: none"> <li>• electric discharge lighting</li> <li>• incandescent</li> </ul>	1/2
O.04	Troubleshoot/replace electrical components of water heaters	1/2
O.05	Troubleshoot/repair/replace overcurrent protective devices	1/2
O.06	Troubleshoot/repair/replace service entrance equipment	1/2
O.07	Replace receptacles or switches	1/2
O.08	Troubleshoot/repair/replace automatic control devices	1/2

O.10	Troubleshoot/replace transformers	1/2
O.11	Troubleshoot/repair/replace electric motors	1/2

**DUTY P: Install and Maintain Special Systems**

CODE	TASK	F/C
P.01	Install ducts <ul style="list-style-type: none"> <li>• busways</li> <li>• feeder</li> <li>• plug-in</li> </ul>	1/3
P.02	Install wireway <ul style="list-style-type: none"> <li>• lay-in</li> <li>• underfloor</li> <li>• surface mount</li> </ul>	1/3
P.03	Install wiring in mounted wireways and cable trays	1/3
P.04	Install circuit breakers, fuses, and disconnecting means	1/3
P.05	Install circuits using nonmetallic sheathed cables	1/3
P.06	Install and connect system grounds	1/3
P.07	Install raceway systems and conductors	1/3
P.08	Install systems in hazardous locations	1/3
P.09	Install battery charging systems	1/3
P.10	Install lighting dimmer systems	1/3
P.11	Install/splice/terminate high-voltage cables and equipment	1/3
P.12	Troubleshoot high-voltage cables and equipment	1/3
P.13	Test the insulation of cables and equipment	1/3
P.14	Troubleshoot/install/replace surge and lightning protector systems	1/3
P.15	Troubleshoot/install/replace grounding, bonding, and circuits	1/3
P.16	Troubleshoot/install/replace pool grounding, bonding, and circuits	1/3

**DUTY Q: Install Transformers**

CODE	TASK	F/C
Q.01	Install and connect transformers <ul style="list-style-type: none"> <li>• step-up</li> <li>• step-down</li> <li>• single-phase</li> <li>• polyphase</li> <li>• current</li> <li>• potential</li> <li>• boost</li> <li>• buck</li> </ul>	1/3
Q.02	Test transformer for output and performance under load	1/3
Q.03	Clean power transformer	1/3
Q.04	Connect a dual-voltage transformer for <ul style="list-style-type: none"> <li>• highest input/output</li> <li>• low input/output</li> </ul>	1/3
Q.05	Connect auto transformer to give a variety of voltages	1/3
Q.06	Connect power-supply distribution transformer to supply	1/3

	<ul style="list-style-type: none"> <li>• Three-phase, four-wire connections</li> <li>• Three-phase, delta configuration</li> <li>• Three-phase, wye-configuration</li> </ul>	
Q.07	Connect three single-phase transformers to form a <ul style="list-style-type: none"> <li>• Delta-delta configuration (3 or 4 wire)</li> <li>• Delta-wye configuration</li> <li>• Wye-delta configuration</li> <li>• Wye-wye configuration</li> <li>• Corner grounded delta configuration</li> </ul>	1/3
Q.08	Connect two single-phase transformers in <ul style="list-style-type: none"> <li>• An open delta configuration (3 or 4 wire)</li> <li>• Parallel</li> </ul>	1/3
Q.09	Connect a voltmeter to a power line through the use of a potential transformer	1/3
Q.10	Connect an amp meter to high voltage line using current transformer	1/3

#### **DUTY R: Install AC and DC Rotating Equipment**

<b>CODE</b>	<b>TASK</b>	<b>F/C</b>
R.01	Install/connect/replace DC circuits <ul style="list-style-type: none"> <li>• Shunt</li> <li>• Series</li> <li>• Compound</li> </ul>	1/2
R.02	Install/connect/replace DC generators <ul style="list-style-type: none"> <li>• Separately-excited shunt</li> <li>• Self-excited</li> <li>• Compound</li> <li>• Series</li> </ul>	1/2
R.03	Change the output of DC generator	1/2
R.04	Change the direction of rotation of electrical motors	1/2
R.05	Install/connect AC motors	1/2
R.06	Install/connect/replace AC alternator	1/2
R.07	Install/connect phase converters	1/2
R.08	Connect single-phase AC motor to run from different voltages	1/2
R.09	Connect three-phase AC motor to run from different voltages	1/2
R.10	Connect three-phase motor stator for <ul style="list-style-type: none"> <li>• Delta operation</li> <li>• Wye operation</li> </ul>	1/2
R.11	Connect/replace motors <ul style="list-style-type: none"> <li>• capacitor-run</li> <li>• capacitor-start</li> <li>• repulsion-start, induction-run</li> <li>• split-phase induction</li> <li>• universal</li> <li>• three-phase wound-rotor induction</li> <li>• three-phase synchronous</li> </ul>	1/2

	<ul style="list-style-type: none"> <li>• shaded-pole</li> <li>• three-phase squirrel-cage induction</li> </ul>	
R.12	Connect a three-phase alternator	1/2

**DUTY S: Construct, Install, and Maintain Electrical Control Systems and Devices**

CODE	TASK	F/C
S.01	Install, troubleshoot, and repair motor control systems <ul style="list-style-type: none"> <li>• Single-phase system</li> <li>• Three-phase system</li> <li>• Magnetic motor starters</li> <li>• Hand off, automatic systems</li> <li>• Interlocking, reversing systems</li> <li>• Hand sequence systems</li> <li>• Timed sequence systems</li> <li>• Automatic sequence systems</li> <li>• Jogging systems</li> <li>• Plugging systems</li> <li>• Multiple station systems               <ul style="list-style-type: none"> <li>• 3-wire motor control systems</li> <li>• 5-wire motor control systems</li> </ul> </li> <li>• Reversing motor control systems               <ul style="list-style-type: none"> <li>• Using drum switches</li> <li>• Using reversing starters</li> </ul> </li> <li>• Overload relays</li> </ul>	1/2
S.02	Install, troubleshoot, and repair solid state motor control systems <ul style="list-style-type: none"> <li>• Silicon controlled rectifier (SCR) and Triac systems</li> <li>• Transistor speed control systems</li> <li>• Closed-loop speed control systems</li> <li>• Pulse width speed control systems</li> <li>• Pulse-triggered speed control systems</li> </ul>	1/2
S.03	Install, troubleshoot, and repair special purpose motor control systems <ul style="list-style-type: none"> <li>• AC reduced voltage starters (resistance)</li> <li>• Part winding starters</li> <li>• Three-phase multi-speed controllers</li> <li>• DC motor controllers</li> <li>• Pilot-motor-driven timing controls</li> </ul>	1/2
S.04	Install, troubleshoot, and repair motor driven systems <ul style="list-style-type: none"> <li>• Electric braking devices and systems               <ul style="list-style-type: none"> <li>• Dynamic braking circuit for DC motor</li> <li>• Braking circuit for AC motor</li> <li>• Direct drive stations</li> <li>• Gear motor stations</li> </ul> </li> </ul>	1/2
S.05	Install, troubleshoot and repair sensors, controls and relay control systems	1/2

	<ul style="list-style-type: none"> <li>• control relay systems</li> <li>• photoelectric cells</li> <li>• photoelectric relay circuits</li> <li>• rheostats/potentiometers</li> <li>• control switches</li> <li>• flow switches</li> <li>• pressure switches</li> <li>• thermostats</li> <li>• time delay relays <ul style="list-style-type: none"> <li>• on-delay</li> <li>• off-delay</li> </ul> </li> <li>• potential-type motor starting relay</li> </ul>	
S.06	<p>Troubleshoot and repair solid state devices in control systems</p> <ul style="list-style-type: none"> <li>• Solid state rectifiers <ul style="list-style-type: none"> <li>• Single phase</li> <li>• Three phase</li> <li>• Half-wave</li> <li>• Full-wave</li> </ul> </li> <li>• Silicone controlled rectifiers</li> <li>• Triacs</li> <li>• Voltage regulators <ul style="list-style-type: none"> <li>• Linear</li> <li>• Switching</li> </ul> </li> </ul>	1/2
S.07	Install, troubleshoot and repair power distribution systems for computers	1/2
S.08	Install, troubleshoot and repair control wiring for a programmable controller system	1/2

**DUTY T: Install Low-voltage and Data Communications Systems**

CODE	TASK	F/C
T.01	Troubleshoot/install/connect/replace power and control transformers	1/1
T.02	Troubleshoot/install/connect/replace door chime systems	1/1
T.03	Troubleshoot/install/connect/replace intercom systems	1/1
T.04	Troubleshoot/install/connect/replace telephone systems	1/1
T.05	<p>Troubleshoot/install/connect/repair/replace emergency warning systems</p> <ul style="list-style-type: none"> <li>• fire</li> <li>• burglar</li> </ul>	1/1
T.06	Troubleshoot/install/connect/replace digital communications cabling	1/1
T.07	Troubleshoot/install/connect/replace fiber optic communications cabling	1/1
T.08	Troubleshoot/install/connect/replace public address systems	1/1
T.09	Troubleshoot/install/connect/replace under carpet cabling systems	1/1
T.10	Install/connect cable television systems	1/1
T.11	<p>Install/connect cables and terminations</p> <ul style="list-style-type: none"> <li>• telephone</li> <li>• computer</li> </ul>	1/1
T.12	Install/connect automatic garage door operator	1/1

**DUTY U: Demonstrate Safety Skills**

<b>CODE</b>	<b>TASK</b>	<b>CIMC</b>
	<b>General Construction Industry Health and Safety</b>	
U.01	Identify common jobsite hazards and discuss the purpose of safety policies	3/3
U.02	Describe the role and discuss the importance of the Occupational Safety and Health Administration (OSHA)	3/3
U.03	Identify and describe OSHA requirements	3/3
U.04	Identify and describe first aid and emergency response procedures	3/3
U.05	Identify fire hazards, and describe fire protection and response procedures	3/3
U.06	Identify and describe safety precautions and procedures for using hand tools, portable power tools, and stationary power equipment	3/3
U.07	Discuss how the use of alcohol, prescription drugs, nonprescription drugs, and controlled substances effects jobsite safety	3/3
U.08	Complete accident/incident report	3/3
	<b>Electrical Safety and Health</b>	
U.09	Identify safety precautions and procedures for working with and around electricity and high voltage transmission equipment	3/3
U.10	Identify precautions for avoiding electrical shock and the procedures to follow when treating victims of electrical shock	3/3
U.11	Identify safety precautions and procedures for working with "live" circuits	3/3
U.12	Identify safety precautions and procedures for using test equipment	3/3
U.13	Identify safety precautions and procedures for installing temporary wiring, power systems, and service installations	3/3
U.14	Identify safety precautions and procedures for installing circuit and feeder disconnects	3/3
U.15	Identify and clearly mark safe working clearances around electrical equipment	3/3
U.16	Describe the safe use of flexible cords and cables	3/3
U.17	Demonstrate knowledge of device and conductor polarity identification	3/3
U.18	Demonstrate knowledge of GFCI applications	3/3

**ELECTRICAL TRADES CURRICULUM CROSSWALK**

**CIMC CURRICULUM**

**(1) MAVCC BASIC WIRING**

**(2) MAVCC RESIDENTIAL WIRING**

**(3) MAVCC COMMERCIAL and INDUSTRIAL WIRING**

**DUTY E: Plan and Organize Work**

CODE	TASK	CIMC
E.01	Plan a sequence of work operations <ul style="list-style-type: none"> <li>• Review plans and specifications</li> </ul>	(3) Projects
E.02	Inventory equipment and supplies	(1) Units 2, 5, 6, 8-17 (2) Units 1-5
E.03	Compile a list of motor nameplate data	(3) Unit 7
E.04	Update schematic print files for machinery	
E.05	Plan a shutdown procedure for a given area	
E.06	Set up a trouble log on maintenance or equipment	
E.07	Compile list of materials from wiring blueprints	(3) Projects
E.08	Coordinate work with public utilities	
E.09	Draw control panel diagrams	
E.10	Draw external power diagrams	(3) Unit 8
E.11	Draw schematic diagrams from pre-wired circuits	(3) Units 4, 9, 10, 12, 14
E.12	Draw an as-built electrical plan	(2) 1 & 4 (3) Projects

**DUTY F: Perform Activities Related to Basic Circuits**

CODE	TASK	CIMC
F.01	Construct/analyze/install series circuits	(1) Unit 10
F.02	Troubleshoot series circuit	
F.03	Draw series circuit and calculate circuit values	(1) Unit 10
F.04	Construct/analyze/install parallel circuits	(1) Unit 10
F.05	Troubleshoot parallel circuits	
F.06	Draw parallel circuit and calculate circuit values	(1) Unit 10
F.07	Construct/analyze/install series-parallel circuits	(1) Unit 10
F.08	Troubleshoot series-parallel circuits	
F.09	Draw series-parallel circuits and calculate circuit values	(1) Unit 10
F.10	Set up and operate for basic circuits <ul style="list-style-type: none"> <li>• volt amp meter</li> <li>• ohmmeter</li> <li>• voltage tester</li> </ul>	(1) Unit 6

**DUTY G: Perform Activities Related to Alternating Current Circuits**

CODE	TASK	CIMC
G.01	Identify alternating current sources	(1) Unit 11
G.02	Analyze and apply principles of transformers to AC circuits <ul style="list-style-type: none"> <li>• buck and boost</li> <li>• low voltage</li> </ul>	(1) Unit 11 (2) Unit 5
G.03	Install single phase circuits	
G.04	Troubleshoot single phase circuits	
G.05	Construct/analyze/install polyphase circuits	(1) Unit 11
G.06	Troubleshoot polyphase circuits	(1) Unit 6
G.07	Remove/replace capacitors in an AC circuit	
G.08	Test capacitors in an AC circuit	(1) Unit 11 (3) Unit 4
G.09	Install power transformers	
G.10	Troubleshoot power transformers	
G.11	Install control transformers	
G.12	Troubleshoot control transformers	
G.13	Make proper connections on dual voltage motors	
G.14	Make proper connections on dual voltage generators	
G.15	Set up and operate for AC circuits	(1) Unit 6 & 11 (3) Unit 4 & 7

**DUTY H: Demonstrate Knowledge of NEC Introduction, Definitions, And Requirements For Electrical Installations**

CODE	TASK	CIMC
H.01	Demonstrate knowledge of Article 90 (Introduction)	(1) Unit 7
H.02	Demonstrate knowledge of Article 100 (Definitions)	(1) Unit 7
H.03	Demonstrate knowledge of Article 110 (Requirements for Electrical Installations)	
H.04	Demonstrate knowledge of Article 210 (Branch Circuit Requirements)	
H.05	Demonstrate knowledge of Article 230 (Service Point Locations)	

**DUTY I: Perform Calculations**

CODE	TASK	CIMC
I.01	Calculate and balance the total load per phase	(1) Unit 11
I.02	Calculate the grounding electrode system and bonding requirements <ul style="list-style-type: none"> <li>• size</li> <li>• materials</li> </ul>	(1) Unit 7 (2) Unit 2
I.03	Calculate individual circuits	(1) Unit 13 (3) Unit 1
I.04	Calculate the load in volt-amps and the load current in amps	(1) Unit 11 (2) Unit 1
I.05	Calculate service size <ul style="list-style-type: none"> <li>• branch circuit</li> <li>• feeder circuit</li> </ul>	(2) Unit 2 (3) Projects

	<ul style="list-style-type: none"> <li>• service circuit</li> </ul>	
I.06	Determine the number of convenience and appliance outlets per circuit	(2) Unit 1
I.07	Perform transformer and motor calculations	(1) Unit 13 (3) Unit 1 & 4
I.08	Calculate voltage drop	(1) Unit 11 (3) Projects
I.09	Calculate conductors <ul style="list-style-type: none"> <li>• de-rating</li> <li>• correction factors</li> </ul>	(1) Units 13, 15, 17 (2) Unit 2 (3) Units 1, 5, 9, 10, 12, 13
I.10	Calculate size of raceways and enclosures	
I.11	Calculate over-current protection	(1) Unit 15 (2) Unit 2 (3) Units 1, 9, 10, 12
I.12	Perform calculations using Ohm's Law	(1) Unit 9 & 10

#### DUTY J: Install Services

CODE	TASK	CIMC
J.01	Ground service equipment <ul style="list-style-type: none"> <li>• grounding electrode systems</li> <li>• bonding</li> </ul>	(2) Unit 2 (3) Unit 3
J.02	Size and install service conductors	(1) Unit 16 (2) Unit 2 (3) Unit 3
J.03	Install mast-type service	
J.04	Install main service disconnects (master switches)	(1) Unit 16
J.05	Install circuit breakers in panels	(1) Unit 16
J.06	Install and connect mobile home/office service	
J.07	Install service panels (distribution panel boards)	
J.08	Install temporary service	(3) Unit 3
J.09	Install underground service	(2) Unit 2
J.10	Install metering equipment	(2) Unit 2 (3) Unit 3

#### DUTY K: Install Switch and Outlet Boxes

CODE	TASK	CIMC
K.01	Install and size boxes <ul style="list-style-type: none"> <li>• new construction</li> <li>• existing construction</li> </ul>	

	<ul style="list-style-type: none"> <li>hazardous locations</li> </ul>	
K.02	Install recessed fixture housings in ceilings	(1) Unit 17 (2) Unit 4
K.03	Install bar-hanger mounted box	(1) Unit 11 & 17 (2) Unit 4 (3) Unit 5
K.04	Install flush mount junction box	(2) Unit 4
K.05	Install flush mount switch and outlet box in <ul style="list-style-type: none"> <li>drywall</li> <li>lathe and plaster wall</li> <li>paneled wall</li> <li>masonry wall</li> </ul>	(1) Unit 17 (2) Unit 4 (3) Unit 5
K.06	Install gangable boxes	(2) Unit 4 (3) Unit 5
K.07	Install octagon outlet box	(1) Unit 11 & 17 (2) Unit 4 (3) Unit 5
K.08	Install surface mount junction box	(2) Unit 4 (3) Unit 5
K.09	Install subsurface enclosures	
K.10	Install raceway supported enclosures (314.23)	

#### DUTY L: Rough-in Circuits

CODE	TASK	CIMC
L.01	Lay out electrical systems <ul style="list-style-type: none"> <li>use material and devices labeled and listed for the purpose</li> <li>follow all grounding and bonding requirements</li> </ul>	(2) Unit 4 (3) Unit 5 & Projects
L.02	Rough-in feeders and circuits using a cable system <ul style="list-style-type: none"> <li>new construction</li> <li>existing construction</li> </ul>	(2) Unit 2 (3) Unit 5
L.03	Rough-in and properly secure circuits in conduits and other raceways <ul style="list-style-type: none"> <li>new construction</li> <li>existing construction</li> </ul>	(1) Unit 17 (2) Unit 2
L.04	Rough-in and properly secure cables or conduits for branch circuits	(2) Unit 4 (3) Unit 5
L.05	Connect circuits to circuit breaker panels	(1) Unit 16 (2) Unit 2 & 4 (3) Unit 5
L.06	Rough-in circuits to outlet boxes	(1) Unit 16 (2) Unit 4 (3) Unit 5
L.07	Rough-in cables between existing boxes and newly installed boxes	(1) Unit 17
L.08	Rough-in a circuit for an outlet controlled with <ul style="list-style-type: none"> <li>three-way switches</li> <li>three-way switches and four-way switches</li> <li>feed to the device outlet box</li> <li>feed to the device</li> <li>feed to the three-way switch</li> </ul>	(1) Unit 11 (2) Unit 4 (3) Unit 5

L.09	Rough-in low-voltage circuits <ul style="list-style-type: none"> <li>• door chime system</li> <li>• intercom system</li> </ul>	(1) Unit 14 (2) Unit 5
L.10	Rough-in cables for general purpose branch circuits <ul style="list-style-type: none"> <li>• single pole switch</li> <li>• three-way switch</li> <li>• four-way switch</li> <li>• receptacle outlet</li> <li>• lighting outlet</li> </ul>	(1) Unit 16 (2) Unit 4 (3) Unit 5 & Projects
L.11	Make splices using mechanical-type connectors <ul style="list-style-type: none"> <li>• split bolt connectors</li> <li>• wire nuts</li> </ul>	(1) Unit 12 & 13 (2) Unit 4
L.12	Make joints using crimp type connectors (splices)	
L.13	Make terminations	(1) Unit 13 (2) Unit 4
L.14	Rough-in branch circuit wires to panels	(2) Unit 4 (3) Unit 5
L.15	Install panels and subpanels	(1) Unit 16 (2) Unit 2 (3) Projects
L.16	Run feeder cables from main service panels to subpanels	
L.17	Rough-in weatherproof outlet boxes and covers	(3) Projects
L.19	Rough-in electrical environmental control components	
L.20	Install conduits, cables, raceways, and equipment <ul style="list-style-type: none"> <li>• indoor</li> <li>• outdoor</li> <li>• underground</li> <li>• non-liquid tight flexible metal</li> <li>• liquid-tight flexible metal</li> <li>• rigid</li> <li>• plastic</li> <li>• compensate for expansion</li> <li>• multi-conduit layout</li> <li>• thin wall (EMT)</li> <li>• direct burial</li> <li>• multi-conductor</li> <li>• wet locations</li> <li>• dry locations</li> <li>• submerged locations</li> </ul>	(1) Unit 13 (2) Unit 2 & 4 (3) Unit 5, 16, & Projects
L.21	Install receptacle circuits <ul style="list-style-type: none"> <li>• single phase</li> <li>• three phase</li> </ul>	(2) Unit 4 (3) Unit 5
L.22	Rough-in thermostat wiring <ul style="list-style-type: none"> <li>• low voltage</li> <li>• temperature control</li> </ul>	(1) Unit 13
L.23	Demonstrate knowledge of outside branch circuits and feeders	

**DUTY M: Install Electrical Field Wiring for Environmental Control Systems**

CODE	TASK	CIMC
M.01	Install/connect baseboard heating systems	
M.02	Install/connect wall heaters	
M.03	Install/connect ceiling heat cables	
M.04	Connect central electric heat	
M.05	Install individual space heaters	
M.06	Connect thermostats <ul style="list-style-type: none"> <li>• line voltage</li> <li>• low-voltage</li> </ul>	
M.07	Connect furnace motors	
M.08	Connect gas/oil fired heating units	
M.09	Connect wiring for boiler control systems	
M.10	Install/connect for ventilation systems	(3) Projects
M.11	Install/connect for air conditioning systems	(2) Unit 4
M.12	Install/connect all associated field wiring for environmental controls	

**DUTY N: Trim Out (Finish) Electrical Devices and Appliances**

CODE	TASK	CIMC
N.01	Install/connect all lighting fixtures and circuits	(2) Unit 4
N.02	Install/connect paddle fans	(2) Unit 4
N.03	Install/connect a photoelectric control on a light	
N.04	Install/connect heat-a-vent lights	
N.05	Install/connect post lights	
N.06	Determine the proper location for and install/connect emergency lighting systems	
N.07	Install/connect receptacles	(2) Unit 4
N.08	Install/connect switches	(2) Unit 4
N.09	Install/connect time switches <ul style="list-style-type: none"> <li>• delayed action</li> </ul>	
N.10	Install/connect appliances	(2) Unit 4
N.11	Connect sump and well pump motors	(3) Projects
N.12	Install/connect panels	(3) Projects
N.13	Install/connect de-icing equipment	
N.14	Install/connect low-voltage systems	(2) Unit 5 (3) Unit 10
N.15	Install/connect ground fault interrupting devices	
N.16	Connect water heaters	
N.17	Connect humidity control devices	
N.18	Install/connect circuits for hydromassage tubs	
N.19	Install/connect pilot indicating lights	
N.20	Determine the proper location for and install smoke and CO detectors	(1) Unit 14 (2) Unit 5 (3) Unit 5
N.21	Install/connect lighting dimmer systems	

**DUTY O: Maintain and Repair Existing Wiring Systems**

CODE	TASK	CIMC
O.01	Troubleshoot/repair/replace HVAC system controls	
O.02	Troubleshoot/repair/replace relays and timers	(3) Projects
O.03	Troubleshoot/repair/replace lighting fixtures <ul style="list-style-type: none"> <li>• electric discharge lighting</li> <li>• incandescent</li> </ul>	(2) Unit 4
O.04	Troubleshoot/replace electrical components of water heaters	
O.05	Troubleshoot/repair/replace overcurrent protective devices	
O.06	Troubleshoot/repair/replace service entrance equipment	(2) Unit 4
O.07	Replace receptacles or switches	
O.08	Troubleshoot/repair/replace automatic control devices	
O.10	Troubleshoot/replace transformers	
O.11	Troubleshoot/repair/replace electric motors	(3) Unit 7

**DUTY P: Install and Maintain Special Systems**

CODE	TASK	CIMC
P.01	Install ducts <ul style="list-style-type: none"> <li>• busways</li> <li>• feeder</li> <li>• plug-in</li> </ul>	
P.02	Install wireway <ul style="list-style-type: none"> <li>• lay-in</li> <li>• underfloor</li> <li>• surface mount</li> </ul>	(1) Unit 17
P.03	Install wiring in mounted wireways and cable trays	
P.04	Install circuit breakers, fuses, and disconnecting means	
P.05	Install circuits using nonmetallic sheathed cables	
P.06	Install and connect system grounds	(2) Unit 4
P.07	Install raceway systems and conductors	(2) Unit 2
P.08	Install systems in hazardous locations	(3) Projects
P.09	Install battery charging systems	
P.10	Install lighting dimmer systems	
P.11	Install/splice/terminate high-voltage cables and equipment	
P.12	Troubleshoot high-voltage cables and equipment	
P.13	Test the insulation of cables and equipment	(3) Unit 4
P.14	Troubleshoot/install/replace surge and lightning protector systems	
P.15	Troubleshoot/install/replace grounding, bonding, and circuits	
P.16	Troubleshoot/install/replace pool grounding, bonding, and circuits	

**DUTY Q: Install Transformers**

CODE	TASK	CIMC
Q.01	Install and connect transformers <ul style="list-style-type: none"> <li>• step-up</li> <li>• step-down</li> </ul>	(3) Unit 4

	<ul style="list-style-type: none"> <li>• single-phase</li> <li>• polyphase</li> <li>• current</li> <li>• potential</li> <li>• boost</li> <li>• buck</li> </ul>	
Q.02	Test transformer for output and performance under load	(3) Unit 4
Q.03	Clean power transformer	
Q.04	Connect a dual-voltage transformer for <ul style="list-style-type: none"> <li>• highest input/output</li> <li>• low input/output</li> </ul>	
Q.05	Connect auto transformer to give a variety of voltages	
Q.06	Connect power-supply distribution transformer to supply <ul style="list-style-type: none"> <li>• Three-phase, four-wire connections</li> <li>• Three-phase, delta configuration</li> <li>• Three-phase, wye-configuration</li> </ul>	
Q.07	Connect three single-phase transformers to form a <ul style="list-style-type: none"> <li>• Delta-delta configuration (3 or 4 wire)</li> <li>• Delta-wye configuration</li> <li>• Wye-delta configuration</li> <li>• Wye-wye configuration</li> <li>• Corner grounded delta configuration</li> </ul>	(3) Unit 4
Q.08	Connect two single-phase transformers in <ul style="list-style-type: none"> <li>• An open delta configuration (3 or 4 wire)</li> <li>• Parallel</li> </ul>	
Q.09	Connect a voltmeter to a power line through the use of a potential transformer	
Q.10	Connect an amp meter to high voltage line using current transformer	

#### DUTY R: Install AC and DC Rotating Equipment

CODE	TASK	CIMC
R.01	Install/connect/replace DC circuits <ul style="list-style-type: none"> <li>• Shunt</li> <li>• Series</li> <li>• Compound</li> </ul>	
R.02	Install/connect/replace DC generators <ul style="list-style-type: none"> <li>• Separately-excited shunt</li> <li>• Self-excited</li> <li>• Compound</li> <li>• Series</li> </ul>	
R.03	Change the output of DC generator	
R.04	Change the direction of rotation of electrical motors	(3) Unit 13
R.05	Install/connect AC motors	
R.06	Install/connect/replace AC alternator	
R.07	Install/connect phase converters	
R.08	Connect single-phase AC motor to run from different voltages	

R.09	Connect three-phase AC motor to run from different voltages	(3) Unit 7
R.10	Connect three-phase motor stator for <ul style="list-style-type: none"> <li>• Delta operation</li> <li>• Wye operation</li> </ul>	
R.11	Connect/replace motors <ul style="list-style-type: none"> <li>• capacitor-run</li> <li>• capacitor-start</li> <li>• repulsion-start, induction-run</li> <li>• split-phase induction</li> <li>• universal</li> <li>• three-phase wound-rotor induction</li> <li>• three-phase synchronous</li> <li>• shaded-pole</li> <li>• three-phase squirrel-cage induction</li> </ul>	
R.12	Connect a three-phase alternator	

**DUTY S: Construct, Install, and Maintain Electrical Control Systems and Devices**

CODE	TASK	CIMC
S.01	Install, troubleshoot, and repair motor control systems <ul style="list-style-type: none"> <li>• Single-phase system</li> <li>• Three-phase system</li> <li>• Magnetic motor starters</li> <li>• Hand off, automatic systems</li> <li>• Interlocking, reversing systems</li> <li>• Hand sequence systems</li> <li>• Timed sequence systems</li> <li>• Automatic sequence systems</li> <li>• Jogging systems</li> <li>• Plugging systems</li> <li>• Multiple station systems <ul style="list-style-type: none"> <li>• 3-wire motor control systems</li> <li>• 5-wire motor control systems</li> </ul> </li> <li>• Reversing motor control systems <ul style="list-style-type: none"> <li>• Using drum switches</li> <li>• Using reversing starters</li> </ul> </li> <li>• Overload relays</li> </ul>	(3) Unit 7, 9, 11-14, & Projects
S.02	Install, troubleshoot, and repair solid state motor control systems <ul style="list-style-type: none"> <li>• Silicon controlled rectifier (SCR) and Triac systems</li> <li>• Transistor speed control systems</li> <li>• Closed-loop speed control systems</li> <li>• Pulse width speed control systems</li> <li>• Pulse-triggered speed control systems</li> </ul>	
S.03	Install, troubleshoot, and repair special purpose motor control systems <ul style="list-style-type: none"> <li>• AC reduced voltage starters (resistance)</li> <li>• Part winding starters</li> </ul>	(3) Unit 9, 10, & Projects

	<ul style="list-style-type: none"> <li>• Three-phase multi-speed controllers</li> <li>• DC motor controllers</li> <li>• Pilot-motor-driven timing controls</li> </ul>	
S.04	Install, troubleshoot, and repair motor driven systems <ul style="list-style-type: none"> <li>• Electric braking devices and systems             <ul style="list-style-type: none"> <li>• Dynamic braking circuit for DC motor</li> <li>• Braking circuit for AC motor</li> <li>• Direct drive stations</li> <li>• Gear motor stations</li> </ul> </li> </ul>	
S.05	Install, troubleshoot and repair sensors, controls and relay control systems <ul style="list-style-type: none"> <li>• control relay systems</li> <li>• photoelectric cells</li> <li>• photoelectric relay circuits</li> <li>• rheostats/potentiometers</li> <li>• control switches</li> <li>• flow switches</li> <li>• pressure switches</li> <li>• thermostats</li> <li>• time delay relays             <ul style="list-style-type: none"> <li>• on-delay</li> <li>• off-delay</li> </ul> </li> <li>• potential-type motor starting relay</li> </ul>	(3) Unit 9, 10, 12, 14, & Projects
S.06	Troubleshoot and repair solid state devices in control systems <ul style="list-style-type: none"> <li>• Solid state rectifiers             <ul style="list-style-type: none"> <li>• Single phase</li> <li>• Three phase</li> <li>• Half-wave</li> <li>• Full-wave</li> </ul> </li> <li>• Silicone controlled rectifiers</li> <li>• Triacs</li> <li>• Voltage regulators             <ul style="list-style-type: none"> <li>• Linear</li> <li>• Switching</li> </ul> </li> </ul>	(3) Unit 10
S.07	Install, troubleshoot and repair power distribution systems for computers	
S.08	Install, troubleshoot and repair control wiring for a programmable controller system	(3) Unit 10 & 15
S.09	Install control systems using Class 1, Class 2, and Class 3 wiring materials and methods	(3) Unit 14

**DUTY T: Install Low-voltage and Data Communications Systems**

CODE	TASK	CIMC
T.01	Troubleshoot/install/connect/replace power and control transformers	(2) Unit 5
T.02	Troubleshoot/install/connect/replace door chime systems	(1) Unit 14 (2) Unit 5
T.03	Troubleshoot/install/connect/replace intercom systems	
T.04	Troubleshoot/install/connect/replace telephone systems	(2) Unit 5

T.05	Troubleshoot/install/connect/repair/replace emergency warning systems <ul style="list-style-type: none"> <li>• fire</li> <li>• burglar</li> </ul>	(1) Unit 14 (2) Unit 5
T.06	Troubleshoot/install/connect/replace digital communications cabling	
T.07	Troubleshoot/install/connect/replace fiber optic communications cabling	
T.08	Troubleshoot/install/connect/replace public address systems	
T.09	Troubleshoot/install/connect/replace under carpet cabling systems	
T.10	Install/connect cable television systems	
T.11	Install/connect cables and terminations <ul style="list-style-type: none"> <li>• telephone</li> <li>• computer</li> </ul>	
T.12	Install/connect automatic garage door operator	

**DUTY U: Demonstrate Safety Skills**

CODE	TASK	CIMC
	<b>General Construction Industry Health and Safety</b>	
U.01	Identify common jobsite hazards and discuss the purpose of safety policies	(3) All units
U.02	Describe the role and discuss the importance of the Occupational Safety and Health Administration (OSHA)	(1) All units (2) All units (3) All Units
U.03	Identify and describe OSHA requirements <ul style="list-style-type: none"> <li>• Lock out/Tag out procedures</li> <li>• HAZCOM</li> <li>• MSDS</li> <li>• Exposure to blood borne pathogens</li> <li>• Personal protective equipment</li> <li>• Working in confined spaces</li> <li>• Ladders, scaffolding, and fall arrest systems</li> <li>• Proper lifting procedures</li> <li>• Reporting work site hazards</li> </ul>	(1) All units (2) All units (3) All units
U.04	Identify and describe first aid and emergency response procedures	(1) All units (2) All units (3) All units
U.05	Identify fire hazards, and describe fire protection and response procedures	(1) All units (2) All units (3) All units
U.06	Identify and describe safety precautions and procedures for using hand tools, portable power tools, and stationary power equipment	(1) All units (2) All units (3) All units
U.07	Discuss how the use of alcohol, prescription drugs, nonprescription drugs, and controlled substances effects jobsite safety	(1) All units (2) All units (3) Unit 1 & Projects
U.08	Complete accident/incident report	(1) All units (2) All units (3) All units
	<b>Electrical Safety and Health</b>	
U.09	Identify safety precautions and procedures for working with and around	

	electricity and high voltage transmission equipment	
U.10	Identify precautions for avoiding electrical shock and the procedures to follow when treating victims of electrical shock	(1) All units (2) All units (3) All units
U.11	Identify safety precautions and procedures for working with "live" circuits	(1) All units (2) All units (3) All units
U.12	Identify safety precautions and procedures for using test equipment	(1) All units (2) All units (3) All units
U.13	Identify safety precautions and procedures for installing temporary wiring, power systems, and service installations	(1) All units (2) All units (3) All units
U.14	Identify safety precautions and procedures for installing circuit and feeder disconnects	
U.15	Identify and clearly mark safe working clearances around electrical equipment	(1) All units (2) All units (3) All units
U.16	Describe the safe use of flexible cords and cables	(1) Units 1, 2, 12, 13, & 14 (2) Units 3 & 4 (3) Unit 2
U.17	Demonstrate knowledge of device and conductor polarity identification	(1) All units (2) All units (3) All units
U.18	Demonstrate knowledge of GFCI applications	(1) All units (2) All units (3) All units