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## First Year

### Lesson 101 - Orientation and Basic Principles

- 101.1 **DESCRIBE** and **EXPLAIN** the apprenticeship policies and procedures of the IEC chapter sponsoring your training program.
- 101.2 **LIST** and **EXPLAIN** the advantages of being part of the IEC apprenticeship program.
- 101.3 **DESCRIBE** and **EXPLAIN** the IEC 4-year electrical apprenticeship program.
- 101.4 **RECOGNIZE** basic electrical terms.
- 101.5 **RECOGNIZE** basic NEC® definitions (Article 100).

### Lesson 102 - Tools and Fasteners\*

- 102.1 **RECOGNIZE** hand tools used in the trade by identifying the “do’s and don’ts” of their use and care.\*
- 102.2 **RECOGNIZE** power tools used in the trade by identifying the “do’s and don’ts” of their use and care.
- 102.3 **DESCRIBE** torque wrenches and their use.
- 102.4 **RECALL** and **DEMONSTRATE** knowledge of electrical materials.
- 102.5 **IDENTIFY** hands-on tool activity.

### Lesson 103 - Introduction to Safety, Navigating the NEC® and EWR Plans

- 103.1 **STATE** and **EXPLAIN** the GHS symbols and requirements.
- 103.2 **RECOGNIZE** requirements of NFPA 70E® on flexible cords and cables, highlighting GFCI protection and electrical hazards.
- 103.3 **STATE** general safety considerations in electrical installations.
- 103.4 **OUTLINE** a basic understanding of the creation and organization of the NEC®.
- 103.5 **DESCRIBE** the components of plans and specifications.

### Lesson 104 - Introduction to Electric Charges and Basic Math

- 104.1 **RECOGNIZE** the law of electric charges and theories of current flow.
- 104.2 **ILLUSTRATE** knowledge of basic mathematics.

### Lesson 105 - Applied Math, Circuit Theory, Plans & Specs

- 105.1 **MASTER** whole numbers, decimals, percentages, averages, fractions, and linear measures necessary in solving problems encountered by electricians.
- 105.2 **MASTER** conversions between English and metric units, Fahrenheit and Celsius temperatures; and conduct conversions among metric prefixes.
- 105.3 **POSSESS** a fundamental awareness of resistance, power, and electrical circuits.
- 105.4 **DESCRIBE** the basic information available on the EWR plans and specifications.

### Lesson 106 - Applied Math, Ohm’s Law, Electrical Symbols, and Boxes

- 106.1 **MASTER** ratios, proportions, squared and square root numbers, area, and volume by applying their uses as a means of solving problems encountered by electricians.
- 106.2 **RECOGNIZE** the relationship between voltage, current, and resistance as demonstrated in Ohm’s Law.
- 106.3 **CONTRAST** results of using different applied voltages and resistances as demonstrated in Ohm’s Law.
- 106.4 **RECOGNIZE** various outlet boxes by identifying each outlet box’s characteristics.
- 106.5 **DESCRIBE** symbols presented within the text.

### Lesson 107 - Conduit Bending\*

- 107.1 **LABEL** the points on a hand bender and **LIST** terms used in conduit bending.\*
- 107.2 **OUTLINE** mathematical calculations and apply them to bending conduit.
- 107.3 **DEMONSTRATE** conduit bending hands-on activity.

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Lesson 108 - Dwelling Circuit Requirements, Outlet Locations, and General Lighting Load*	
108.1	<b>DEFINE</b> circuit requirements in dwellings. <b>RECOGNIZE</b> the circuit requirement differences between a dwelling and a non-dwelling.
108.2	<b>DEFINE</b> outlet locations in dwellings. <b>RECOGNIZE</b> the outlet location differences between a dwelling and a non-dwelling.
108.3	<b>OUTLINE</b> NEC® calculation for the general lighting load.
Lesson 109 - Conductor Types, Ampacity, Overcurrent Protection, Type NM Cables, and Common Voltage Systems	
109.1	<b>STATE</b> appropriate insulation and material characteristics according to conductor types.
109.2	<b>SELECT</b> OCPD and conductor size for given loads.
109.3	<b>LIST</b> nonmetallic cable (NM-B and NM-B-PCS) installation requirements.
109.4	<b>RECOGNIZE</b> voltages from common voltage systems.
Lesson 110 - Voltage Drop, Cable, Conduit, and Tubing*	
110.1	<b>RECOGNIZE</b> and solve various single-phase voltage drop calculations using the K-method.
110.2	<b>LIST</b> cable installation requirements for Types AC and MC.
110.3	<b>LIST</b> conduit and tubing installation requirements.
Lesson 111 - Midterm Review and Exam	
111	This lesson will determine your proficiency in the subject matter from the previous lessons.
Lesson 112 - Conductor Terminology, Switches, and Receptacles*	
112.1	<b>SELECT</b> between grounding, grounded, and ungrounded conductors.
112.2	<b>DESCRIBE</b> the NEC® requirements for switches.
112.3	<b>RECOGNIZE</b> the construction, operation, and connection of switches.*
112.4	<b>RECOGNIZE</b> the construction and connection of receptacles by identifying each receptacle and its NEMA designation.
112.5	<b>DESCRIBE</b> the NEC® requirements for receptacles.
Lesson 113 - GFCI, AFCI, and Other Special-Purpose Receptacles*	
113.1	<b>RECOGNIZE</b> the purpose, operation, and installation of GFCI protective devices.*
113.2	<b>RECOGNIZE</b> the purpose, operation, and installation of AFCI protective devices.
113.3	<b>RECOGNIZE</b> the purpose, operation, and installation of TVSS, SPD, IG, hospital grade, and ALCI protective devices.
113.4	<b>DESCRIBE</b> the NEC® requirements for GFCI, AFCI, TVSS, SPD, IG, ALCI, and hospital grade protective devices.
113.5	<b>DESCRIBE</b> receptacle/GFCI/AFCI functions (referencing EWR plan).
Lesson 114 - Luminaires, Ballasts, and Lamps	
114.1	<b>RECOGNIZE</b> the purpose, operation, and installation of a luminaire. <b>DESCRIBE</b> thermal protection for luminaires.
114.2	<b>SELECT</b> ballast and lamp applications for luminaires.
114.3	<b>LIST</b> basic lighting terminology.
114.4	<b>DESCRIBE</b> the NEC® requirements for luminaires.
114.5	<b>DESCRIBE</b> the cost benefits of using energy efficient lighting.

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## Lesson 115 - Box Fill and Introduction to Series Circuits (Front Bedroom)

- 115.1 **RECOGNIZE** lighting requirements in clothes closets and storage areas, per NEC®.
- 115.2 Using the EWR plans, **LOCATE** the circuits and outlets in the front bedroom, based on specifications.
- 115.3 **SELECT** Ohm's Law formulas for series circuits.
- 115.4 **OUTLINE** the minimum NEC® requirements for box fill.

## Lesson 116 - Box Sizing and Series Circuits (Master Bedroom)\*

- 116.1 Using the EWR plans, **LOCATE** the circuits and outlets in the Master Bedroom based on specifications and NEC® requirements.
- 116.2 **SELECT** proper box sizing for receptacle outlet, switch outlet, lighting outlet, and fan outlet. **RECALL** box fill calculations.
- 116.3 **RECOGNIZE** individual and series-connected DC power sources.\*
- 116.4 **LABEL** "unknowns" for series circuits using Ohm's Law formulas.
- 116.5 **RECOGNIZE** and solve various single phase voltage drop calculations using the resistance method.

## Lesson 117 - Lighting and Small Appliance Branch Circuits

- 117.1 Using the EWR plans, **LOCATE** the circuits and lighting in the bathrooms, hallways, foyer, and porch, based on specifications and NEC® requirements.
- 117.2 **DESCRIBE** installation for all indoor and outdoor lighting fixtures.
- 117.3 **RECOGNIZE** small-appliance branch circuit and receptacle outlet installation based on NEC® requirements.
- 117.4 **DRAW** a wiring diagram of cable layout and requirements for the kitchen small appliance circuits.

## Lesson 118 - First Semester Final Exam

- 118 This lesson will determine your proficiency in the subject matter from the previous lessons.

## Lesson 119 - Track Lighting, Dimmers, and Introduction to Parallel Circuits (Living Room)\*

- 119.1 **DESCRIBE** the NEC® requirements for track lighting.
- 119.2 **RECOGNIZE** the operation and connection of dimmers.
- 119.3 **ILLUSTRATE** the layout of the living room and the bedroom/study circuits using specifications and the NEC®.
- 119.4 **RECOGNIZE** parallel-connected DC power sources.\*
- 119.5 **SELECT** Ohm's Law formulas for parallel circuits.

## Lesson 120 - Laundry and Bathroom Receptacles and Parallel Circuits

- 120.1 **DEFINE** the NEC® circuit and receptacle requirements for electrical clothes dryer outlets.
- 120.2 **DEFINE** the NEC® circuit and receptacle requirements for bathrooms, laundry room receptacles, and the installation requirements for exhaust and attic fans.
- 120.3 **FORMULATE** Ohm's Law while performing circuit calculations for parallel circuits.
- 120.4 **ILLUSTRATE** the layout of the laundry and attic and demonstrate an understanding of the layout using specifications and the NEC®.

## Lesson 121 - Garage and Garage Door Circuits, Underground Installations, and Parallel Circuit Calculations

- 121.1 **DEFINE** NEC® requirements for branch circuit wiring protection for garages.
- 121.2 **DESCRIBE** underground requirements using conduit and nonmetallic cable.
- 121.3 **DESCRIBE** garage door opener circuitry including power and control wiring.
- 121.4 **SELECT** parallel circuit calculations for voltage, current, and power.

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## Lesson 122 - Appliance and Special Purpose Outlets

- 122.1 **RECOGNIZE** branch circuit installation for special purpose outlets based on NEC® requirements.
- 122.2 **RECOGNIZE** the NEC® requirements for water heaters and their related disconnecting means, grounding, and overcurrent protection.
- 122.3 **RECOGNIZE** the expected voltmeter measurements across open and closed switches.
- 122.4 Using the EWR plans, **LOCATE** the circuits and information concerning the pump and water heater.

## Lesson 123 - Ranges, Ovens, Counter-Mounted Cooking Units, and Other Kitchen Appliances

- 123.1 **MATCH** circuit and receptacle installation for kitchen ranges, ovens, and counter-mounted cooking equipment based on NEC® requirements.
- 123.2 **MATCH** the NEC® requirements for circuit and receptacle installation for kitchen appliances such as dishwashers and food waste disposals.
- 123.3 **SELECT** between direct (hard-wired/permanent) connections and cord-and-plug connections for kitchen equipment. **DESCRIBE** NEC® requirements for appliance disconnecting means.

## Lesson 124 - Bathrooms, Exhaust Fans, and Hydromassage Tubs

- 124.1 **RECOGNIZE** the circuit installation for ceiling heat/vent/light units in bathrooms based on NEC® requirements.
- 124.2 **STATE** the control circuit wiring for exhaust fans and hydromassage tubs, and identify the required GFCI protection for each.
- 124.3 Using the EWR plans, **LOCATE** the circuit installation for bathrooms based on NEC® requirements.

## Lesson 125 - Heating and Air Conditioning

- 125.1 **RECOGNIZE** circuit installation for heating cable, electric furnaces, electric baseboard heaters, heat pumps, and air conditioners based on NEC® requirements.
- 125.2 **STATE** the NEC® requirements for Class 2 control circuit wiring.
- 125.3 **RECOGNIZE** the data located on the nameplate of HVAC equipment.

## Lesson 126 - Residential Limited Energy Systems\*

- 126.1 **LIST** basic standard installation practices for limited energy residential systems based on NEC® requirements.\*
- 126.2 Using the EWR plans, **LOCATE** the circuits and information concerning low-voltage and fire alarm.

## Lesson 127 - Midterm Review and Exam

- 127 This lesson will determine your proficiency in the subject matter from the previous lessons.

## Lesson 128 - Multiwire Branch Circuits and Introduction to Combination Circuits (Recreation Room)\*

- 128.1 **RECOGNIZE** the method of installation of multiwire branch circuits according to NEC® standards.
- 128.2 **DEFINE** watt loss, voltage drop, and current flow in two-wire and three-wire circuits.
- 128.3 **SELECT** Ohm's Law formulas for combination circuits.
- 128.4 **DESCRIBE** the advantages of installing multiwire branch circuits and the effects on the connected loads when open neutrals occur.\*
- 128.5 **RECOGNIZE** features and voltage of multiple battery connections.

## Lesson 129 - Combination Circuits, Conductor Ampacity Correction, and Conduit Fill (Workshop)\*

- 129.1 **FORMULATE** Ohm's Law while performing circuit calculations for combination circuits.
- 129.2 **SELECT** proper conduit size by utilizing tables 4 and 5 in the NEC®.\*
- 129.3 **STATE** conductor ampacity using correction and adjustment factors. **SELECT** maximum ratings of overcurrent protection for conductors.
- 129.4 **RECOGNIZE** requirements for receptacles in a dwelling unit basement.

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Lesson 130 - Services and Service Equipment, and Cost of Electrical Power*	
130.1	<b>RECOGNIZE</b> the NEC® terminology and requirements for electrical service installations.
130.2	<b>DESCRIBE</b> the cost of using electricity through calculation.
Lesson 131 - Grounding and Bonding, Specialty Tools	
131.1	<b>LIST</b> components of grounding and bonding.
131.2	<b>RECOGNIZE</b> the installation requirements for grounding and bonding as per the NEC®.
131.3	<b>RECOGNIZE</b> and <b>DEMONSTRATE</b> use of specialty tools.
Lesson 132 - Overcurrent Protection and Circuit Conditions	
132.1	<b>RECOGNIZE</b> basic overcurrent device type, terminology and operation.
132.2	<b>RECOGNIZE</b> the NEC® requirements for ratings, sizing, and installation requirements of various OCPDs.
132.3	<b>RECOGNIZE</b> possible circuit conditions (normal, short-circuit, overload, open, ground-fault).
132.4	Using the EWR drawing set, <b>LOCATE</b> information concerning overcurrent protection.
Lesson 133 - Service Entrance Calculations	
133.1	<b>SELECT</b> the size of the electrical service including conductors for a single-family dwelling.
133.2	Using the EWR drawing set, <b>LOCATE</b> information concerning the service calculation.
Lesson 134 - Swimming Pools, Spas, and Hot Tubs	
134.1	<b>RECOGNIZE</b> electrical hazards associated with pools, spas, and hot tubs.
134.2	<b>DESCRIBE</b> installation of electrical wiring for swimming pools, spas, and hot tubs based on NEC® requirements.
134.3	<b>LIST</b> bonding and grounding requirements for swimming pools, spas, and hot tubs based on information provided during class discussions and education materials.
134.4	Using the EWR drawing set, <b>LOCATE</b> information concerning the swimming pool.
Lesson 135 - Home Automation, Standby Power, and Photovoltaic Systems*	
135.1	<b>RECOGNIZE</b> structured wiring and wireless technology installations.
135.2	<b>RECOGNIZE</b> residential standby power systems, the NEC® requirements for installation, and the inherent safety issues.
135.3	<b>RECOGNIZE</b> solar photovoltaic system installation and NEC® requirements.
Lesson 136 - Second Semester Final Exam	
136	This lesson will determine your proficiency in the subject matter from the previous lessons.

\* Additional resources may be found in the back of the book and/or CMS.

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comprehensive list of lesson objectives.**

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Second Year	
Apprenticeship Abbreviations and Special Notes	
Lesson 201 - Construction Materials	
201.1	<b>RECOGNIZE</b> structural supports. <b>DESCRIBE</b> the uses of steel and metal in construction.
201.2	<b>IDENTIFY</b> wood construction materials. <b>DESCRIBE</b> wood framing types and methods.
201.3	<b>DESCRIBE</b> foundation types and foundation assembly methods.
201.4	<b>DESCRIBE</b> masonry types and masonry methods.
201.5	<b>RECOGNIZE</b> insulation, wall coverings, finishes, and firestopping methods.
Lesson 202 - Printreading: Project Design, Development, and Specifications*	
202.1	<b>DESCRIBE</b> project origins and construction professionals.
202.2	<b>INTERPRET</b> the purpose and format of specifications.*
202.3	<b>INTERPRET</b> specifications for the Wendy's restaurant project—Documentation.
202.4	<b>INTERPRET</b> specifications for the Wendy's restaurant project—Construction.
Lesson 203 - Printreading Basics	
203.1	<b>RECOGNIZE</b> and distinguish different prints: title page, civil, structural, architectural, electrical, mechanical, etc.
203.2	<b>INTERPRET</b> general notes, key notes, abbreviations, and symbols.
203.3	<b>RECOGNIZE</b> and <b>IDENTIFY</b> project plan lines, scales, and dimensions.
203.4	<b>RECOGNIZE</b> and distinguish different drawings: elevations, section drawings, detail drawings, and schedules.
Lesson 204 - Electrical Part I: Service, Distribution, and Panel Schedules	
204.1	<b>INTERPRET</b> and <b>LIST</b> electrical materials and methods.
204.2	<b>RECOGNIZE</b> electrical service and distribution components.
204.3	<b>INTERPRET</b> electrical panel schedules.
Lesson 205 - Electrical Part II: Lighting, Power, and Other Associated Drawings	
205.1	<b>INTERPRET</b> electrical lighting drawings.
205.2	<b>INTERPRET</b> electrical power drawings.
205.3	<b>INTERPRET</b> fire-alarm, communications, controls, and security systems.
205.4	<b>INTERPRET</b> electrical quantity take-off.
Lesson 206 - Site/Civil and Structural Drawings	
206.1	<b>LOCATE</b> and <b>USE</b> site, civil, and survey drawings.
206.2	<b>INTERPRET</b> foundation and structural floor plans.
206.3	<b>INTERPRET</b> photometric and site lighting plans.

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## Lesson 207 - Mechanical and Plumbing Materials and Drawings

- 207.1 **INTERPRET** and **LIST** mechanical and plumbing materials and methods.
- 207.2 **INTERPRET** mechanical and plumbing equipment schedules.
- 207.3 **INTERPRET** mechanical drawings.
- 207.4 **INTERPRET** plumbing drawings.
- 207.5 **RECOGNIZE** how roofing types affect electrical installations.

## Lesson 208 - Architectural Drawings

- 208.1 **RECOGNIZE** and **ANALYZE** architectural schedules.
- 208.2 **IDENTIFY** and **EXPLAIN** various wall types and their components.
- 208.3 **RECOGNIZE** and **ANALYZE** architectural details.
- 208.4 **DEMONSTRATE** coordination of drawings.

## Lesson 209 - Midterm Review and Exam

- 209 This lesson will provide a review of the subject matter from previous lessons and determine your proficiency in the subject matter from previous lessons.

## Lesson 210 - Code Study: NEC® Intro, Chapter 1, and Chapter 2, Articles 90, 100, 110, and 200

- 210.1 **IDENTIFY** key concepts and key words in NEC® Article 90.
- 210.2 **IDENTIFY** definitions in NEC® Article 100.
- 210.3 **IDENTIFY** key concepts and key words in NEC® Article 110.
- 210.4 **IDENTIFY** key concepts and key words in NEC® Article 210.

## Lesson 211 - Code Study: NEC® Chapter 2, Article 210

- 211.1 **IDENTIFY** key concepts and key words in NEC® Article 210 Part I.
- 211.2 **IDENTIFY** key concepts and key words in NEC® Article 210 Part II.
- 211.3 **IDENTIFY** key concepts and key words in NEC® Article 210 Part III.

## Lesson 212 - Code Study: NEC® Chapter 2, Articles 215, 220, 225, and 230

- 212.1 **IDENTIFY** key concepts and key words in NEC® Article 215.
- 212.2 **IDENTIFY** key concepts and key words in NEC® Article 220.
- 212.3 **IDENTIFY** examples in NEC® Informative Annex D and how they relate to Article 220.
- 212.4 **IDENTIFY** key concepts and key words in NEC® Article 225.
- 212.5 **IDENTIFY** key concepts and key words in NEC® Article 230.

## Lesson 213 - Code Study: NEC® Chapter 2, Articles 240, 242, and 250

- 213.1 **IDENTIFY** key concepts and key words in NEC® Article 240.
- 213.2 **IDENTIFY** key concepts and key words in NEC® Article 242.
- 213.3 **IDENTIFY** key concepts and key words in NEC® Article 250, specifically equipment grounding conductors.
- 213.4 **IDENTIFY** key concepts and key words in NEC® Article 250, specifically main bonding jumper and grounding electrode system.

## Lesson 214 - Code Study: NEC® Chapter 3, Articles 300 and 310

- 214.1 **IDENTIFY** key concepts and key words in NEC® Article 300.
- 214.2 **IDENTIFY** key concepts and key words in NEC® Article 310 Parts I and II.
- 214.3 **IDENTIFY** key concepts and key words in NEC® Article 310 Part III.
- 214.4 **IDENTIFY** Chapter 9, Table 8 and its relationship to conductors.

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## Lesson 215 - Code Study: NEC® Chapter 3, Articles 312 and 314\*

- 215.1 **IDENTIFY** key concepts and key words in NEC® Article 312.
- 215.2 **IDENTIFY** key concepts and key words in NEC® Article 314.
- 215.3 **FORMULATE** volume calculations for outlet, device, and junction boxes.\*
- 215.4 **FORMULATE** calculations for pull box sizing.

## Lesson 216 - Code Study: NEC® Chapter 3, Articles 320–393\*

- 216.1 **IDENTIFY** code organization and structure standards as contained in NEC® Articles 320–393.
- 216.2 **IDENTIFY** key concepts and key words for cables as used in NEC® Articles 320–340.
- 216.3 **IDENTIFY** key concepts and key words for conduit and tubing as used in NEC® Articles 342–362.
- 216.4 **IDENTIFY** key concepts and key words for other raceway systems as used in NEC® Articles 366–393.
- 216.5 **IDENTIFY** Chapter 9 Tables 1, 4, and 5 and perform conduit fill calculations.\*

## Lesson 217 - First Semester Final Exam Review

- 217 This lesson will provide a review of the subject matter from previous lessons.

## Lesson 218 - First Semester Final Exam

- 218 This lesson will determine your proficiency in the subject matter from the previous lessons.

## Lesson 219 - Introduction to AC Theory

- 219.1 **DESCRIBE** and **CHOOSE** the terms used for electrical charges, magnetism, and electromagnetism.
- 219.2 **RECOGNIZE** basics of AC power, AC generation, frequency, voltage, and current.
- 219.3 **DEFINE** inductance and capacitance, and **CHOOSE** symbols and formulas for inductors and capacitors.

## Lesson 220 - AC Theory: Inductive and Capacitive Reactance

- 220.1 **DEFINE** and compute inductive reactance and capacitive reactance in an AC circuit.
- 220.2 **DESCRIBE** and predict the leading and lagging effects on the voltage and current relationship when inductive reactance and capacitive reactance are present in an AC circuit.

## Lesson 221 - AC Theory: Impedance and Power Factors\*

- 221.1 **DEFINE** and **COMPUTE** impedance in series and parallel circuits.
- 221.2 **IDENTIFY** the relationship between true power, apparent power, and power factor.\*

## Lesson 222 - Single-Phase Transformers: Theory, Types, and Calculations\*

- 222.1 **DESCRIBE** the basic transformer terms and theory.
- 222.2 **DESCRIBE** basic transformer types.
- 222.3 **MASTER** calculations and connections for single-phase, single-voltage transformers.\*
- 222.4 **MASTER** calculations and connections for single-phase, dual-voltage transformers.\*

## Lesson 223 - Power Generation, Transmission, and Distribution; Introduction to Three-Phase Calculations

- 223.1 **RECOGNIZE** methods and components utilized in the generation, transmission, and distribution of power from various types of power plants.
- 223.2 **FORMULATE** power and current in three-phase systems.



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## Lesson 224 - 3Ø Transformers\*

- 224.1 **RECOGNIZE** and **EXPLAIN** three-phase transformers, three-wire, closed-delta secondary outputs, capacities, and connections. Identify proper primary tap connections and perform calculations.\*
- 224.2 **RECOGNIZE** and **EXPLAIN** three-phase, four-wire, closed-delta secondary outputs, capacities, and connections. **PERFORM** current and power calculations.
- 224.3 **RECOGNIZE** and **EXPLAIN** three-phase, three-wire and four-wire, open-delta secondary outputs, capacities, and connections. **PERFORM** current and power calculations.
- 224.4 **RECOGNIZE** and explain three-phase, four-wire, wye secondary outputs, capacities, and connections for transformers and connected loads.\*
- 224.5 **PERFORM** current, power, and tap calculations for transformers.

## Lesson 225 - Buck-Boost Transformers: Single-Phase Connections and Applications\*

- 225.1 **RECOGNIZE** and **EXPLAIN** additive and subtractive polarity and the output voltages of buck-boost transformers.
- 225.2 **RECOGNIZE** and **CHOOSE** applications involving buck-boost transformers. **PERFORM** the calculations for determining the output voltages and capacities of these transformers.
- 225.3 **COMPUTE** the output voltage when supply voltages are other than the table values.

## Lesson 226 - Balancing Three-Phase Loads, Nonlinear Loads, Three-Phase Fault Currents, and Voltage Drop

- 226.1 **RECOGNIZE** and **EXPLAIN** the terms and solutions associated with balancing loads on wye-connected secondaries.
- 226.2 **RECOGNIZE** and **EXPLAIN** terms, symptoms, and solutions associated with nonlinear loads.
- 226.3 **FORMULATE** three-phase and single-phase bolted-fault currents.
- 226.4 **FORMULATE** three-phase and single-phase voltage drop.

## Lesson 227 - Midterm Review and Exam

- 227 This lesson will provide a review of the subject matter from previous lessons and determine your proficiency in the subject matter from previous lessons.

## Lesson 228 - Code Study: NEC® Chapter 4, Articles 400–408, 410, 422, and 424\*

- 228.1 **IDENTIFY** key concepts and key words concerning flexible cords, cables, and fixture wires as used in NEC® 400 and 402.\*
- 228.2 **IDENTIFY** key concepts and key words concerning switches, receptacles, switchboards, and panelboards as used in NEC® 404, 406, and 408.
- 228.3 **IDENTIFY** key concepts and key words concerning luminaires as used in NEC® 410.
- 228.4 **IDENTIFY** key concepts and key words as used in NEC® 422 and 424.

## Lesson 229 - Code Study: NEC® Chapter 4, Articles 430, 440, 445, 450, and 480

- 229.1 **IDENTIFY** key concepts and key words as used in NEC® 430.
- 229.2 **IDENTIFY** key concepts and key words as used in NEC® 440.
- 229.3 **IDENTIFY** key concepts and key words as used in NEC® 445.
- 229.4 **IDENTIFY** key concepts and key words as used in NEC® 450.
- 229.5 **IDENTIFY** key concepts and key words as used in NEC® 480.

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## Lesson 230 - Code Study: NEC® Chapter 5, Articles 500–506 and 511–516

- 230.1 **IDENTIFY** key concepts and key words as used in NEC® 500, 501, 502, and 503.
- 230.2 **IDENTIFY** key concepts and key words as used in NEC® 504, 505, and 506.
- 230.3 **IDENTIFY** key concepts and key words as used in NEC® 511, 513, 514, and 515.
- 230.4 **IDENTIFY** key concepts and key words as used in NEC® 516.

## Lesson 231 - Code Study: NEC® Chapter 5, Articles 517–590

- 231.1 **IDENTIFY** key concepts and key words as used in NEC® 517.
- 231.2 **IDENTIFY** key concepts and key words as used in NEC® 518–540.
- 231.3 **IDENTIFY** key concepts and key words as used in NEC® 545–555.
- 231.4 **IDENTIFY** key concepts and key words as used in NEC® 590.

## Lesson 232 - Code Study: NEC® Chapter 6, Articles 600–604, 620–645, and 680

- 232.1 **IDENTIFY** key concepts and key words as used in NEC® 600, 604, and 620.
- 232.2 **IDENTIFY** key concepts and key words as used in NEC® 625, 630, 640, and 645.
- 232.3 **IDENTIFY** key concepts and key words as used in NEC® 680.

## Lesson 233 - Code Study: NEC® Chapter 6, Articles 690 and 695

- 233.1 **IDENTIFY** key concepts and key words as used in NEC® 690.
- 233.2 **IDENTIFY** key concepts and key words as used in NEC® 695.

## Lesson 234 - Code Study: NEC® Chapter 7, Articles 700–705, 722, 724, 725, and 760

- 234.1 **IDENTIFY** key concepts and key words as used in NEC® 700, 701, and 702.
- 234.2 **IDENTIFY** key concepts and key words as used in NEC® 705.
- 234.3 **IDENTIFY** key concepts and key words as used in NEC® 722, 724, and 725.
- 234.4 **IDENTIFY** key concepts and key words as used in NEC® 760.

## Lesson 235 - Final Exam Review

- 235 This lesson will provide a review of the subject matter from previous lessons.

## Lesson 236 - Final Exam

- 236 This lesson will determine your proficiency in the subject matter from previous lessons.

\* Additional resources may be found in the back of the book and/or CMS.

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Third Year	
Lesson 301 - Test Instruments, OSHA, NFPA 70E®, and Test Instrument Safety	
301.1	<b>USE</b> and correctly <b>INTERPRET</b> information on a digital meter display. List examples of electrical test instruments and demonstrate their uses.
301.2	<b>RECALL</b> the important key safety requirements relative to OSHA and NFPA 70E®.
301.3	<b>DEMONSTRATE</b> safe test instrument habits by using proper PPE and procedures.
Lesson 302 - Introduction to Grounding and Bonding; General Requirements	
302.1	<b>REVIEW</b> definitions for grounding and bonding.
302.2	<b>IDENTIFY</b> the components and explain the effective ground-fault path to facilitate the OCPD operation.
302.3	<b>IDENTIFY</b> objectionable currents and their effects.
Lesson 303 - System Grounding: Grounded Conductors, Systems Required to be Grounded, and Systems Not Permitted to be Grounded	
303.1	<b>REVIEW</b> the various common AC voltage systems. Determine which ARE REQUIRED to be grounded, which conductors are to be grounded, and which conductors are to be protected by overcurrent devices.
303.2	<b>EXPLAIN</b> a separately derived system.
303.3	<b>REVIEW</b> the various common AC voltage systems. Determine which systems and branch circuits are not required or are not permitted to be grounded.
303.4	<b>DESCRIBE</b> and <b>EXPLAIN</b> installation requirements and properly sized grounded conductors.
Lesson 304 - System Grounding: Separately Derived Systems, Main Bonding Jumpers, and System Bonding Jumpers*	
304.1	<b>RECALL</b> and <b>EXPLAIN</b> the function, installation requirements, and sizing of main and system bonding jumpers.*
304.2	<b>ASSESS</b> grounding and installation requirements for separately derived systems.
304.3	<b>ASSESS</b> the grounding requirements for two or more buildings or structures supplied by feeders or branch circuits.
304.4	<b>ASSESS</b> the grounding requirements for portable and vehicle-mounted generators and impedance grounded systems.
Lesson 305 - Grounding Electrode Systems and Grounding Electrode Conductors*	
305.1	<b>EXPLAIN</b> general requirements for the grounding electrode system. <b>CHOOSE</b> which types of electrodes are permitted and the correct installation of the electrodes.
305.2	<b>REVIEW</b> requirements for grounding electrode conductors.*
305.3	<b>REVIEW</b> sizing for grounding electrode conductors.
Lesson 306 - Supply-Side and Load-Side Bonding Jumpers	
306.1	<b>DEMONSTRATE</b> the requirements for supply-side bonding jumpers including materials used, installation, and sizing.
306.2	<b>DEMONSTRATE</b> the requirements for load-side bonding jumpers including materials used, installation, and sizing.
Lesson 307 - Equipment Grounding and Equipment Grounding Conductors	
307.1	<b>IDENTIFY</b> effective equipment grounding and recognize the difference between short circuit and ground fault.
307.2	<b>REVIEW</b> grounding requirements for fastened-in-place equipment.
307.3	<b>REVIEW</b> sizing for equipment grounding conductors.

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## Lesson 308 - Grounding of Specific Equipment and Conditions

- 308.1 **RECOGNIZE** and list the methods of equipment grounding conductor connections.
- 308.2 **SHOW** the normally non-current-carrying metal parts of equipment and identify the supports that are required to be connected to the equipment grounding conductor of a circuit. Explain why this connection is necessary.
- 308.3 **LOCATE** and **APPLY** the provisions for grounding in Chapter 5 and 6 of the NEC®.

## Lesson 309 - Midterm Review and Exam

- 309 This lesson will determine your proficiency in the subject matter of previous lessons.

## Lesson 310 - DC Motors, AC Single-Phase and Polyphase Motors

- 310.1 **DESCRIBE** and **EXPLAIN** the operation, construction, and required connections for DC motors.
- 310.2 **DESCRIBE** and **EXPLAIN** the operation, construction, and required connections for single-phase AC motors.
- 310.3 **DESCRIBE** and **EXPLAIN** three-phase operation of wound-rotor, synchronous, and squirrel-cage induction motors.
- 310.4 **RECOGNIZE** and **DEMONSTRATE** proper connections of wye- and delta-wound squirrel-cage induction motors.
- 310.5 **RECOGNIZE** enclosure types and nameplate information for three-phase motors.

## Lesson 311 - Motors: General Knowledge and Sizing Branch Circuit Conductors

- 311.1 **SELECT** proper size branch circuit conductors for single-phase motors.
- 311.2 **SELECT** proper size branch circuit conductors for three-phase motors.
- 311.3 **SELECT** proper size flexible cord conductors for motors.
- 311.4 **MASTER** adjustment factors for motor branch circuits due to voltage drop, ambient temperature, and/or multiple conductors in a raceway.

## Lesson 312 - Sizing Motor Short-Circuit and Ground-Fault Protection; Locked Rotor Current

- 312.1 **SELECT** proper size short-circuit and ground-fault protection for single-phase motor branch circuits.
- 312.2 **SELECT** proper size short-circuit and ground-fault protection for polyphase motor branch circuits.
- 312.3 **DESCRIBE** the fundamentals of motor locked rotor current. **COMPUTE** approximate locked rotor current when a motor starts or stalls.
- 312.4 **CONTRAST** the minimum equipment grounding conductor size for motor branch circuit installations and branch circuit installations.

## Lesson 313 - Sizing Motor Overloads and Disconnects

- 313.1 **DESCRIBE** the purpose and function of motor overloads.
- 313.2 **SELECT** overload protection for installation in a motor starter.
- 313.3 **RECOGNIZE** the devices that can be used as a disconnecting means for a motor.

## Lesson 314 - Motor Feeder Conductors, OCPDs, and Tap Conductors

- 314.1 **FORMULATE** proper size motor feeder conductors.
- 314.2 **FORMULATE** proper size motor feeder short-circuit and ground-fault protection.
- 314.3 **FORMULATE** proper size motor feeder tap conductors.

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Lesson 315 - Adjustable-Speed Drive Systems, Code, and Introduction to Motor Speed Control Methods	
315.1	<b>DESCRIBE</b> adjustable-speed drive system technology and <b>CONTRAST</b> it to traditional motor circuitry.
315.2	<b>DESCRIBE</b> and <b>APPLY</b> speed control methods for various classifications of motor loads.
Lesson 316 - AC Equipment, Fire Pumps	
316.1	<b>FORMULATE</b> the minimum size for conductors, safety switches, and OCPDs used for air conditioning and refrigeration equipment branch circuits.
316.2	<b>RECOGNIZE</b> the NEC® requirements for fire pumps.
Lesson 317 - First Semester Exam Review	
317	This lesson will provide a review of the subject matter from previous lessons.
Lesson 318 - First Semester Exam	
318	This lesson will determine your proficiency in the subject matter from previous lessons.
Lesson 319 - Introduction to Ladder Logic, Pushbuttons	
319.1	<b>RECOGNIZE</b> inputs and outputs. <b>LABEL</b> various switches and loads as input or output.
319.2	<b>RECOGNIZE</b> correct symbology and operation for toggle switches, pushbuttons, and basic loads.
319.3	<b>WRITE</b> simple ladder diagrams. <b>LABEL</b> ladder diagrams.
Lesson 320 - Manual Control Devices, Hands-On Activity*	
320.1	<b>RECOGNIZE</b> correct symbology and operation for manual control devices (pushbuttons, selector switches, joysticks, and foot switches).
320.2	From the work description, <b>ILLUSTRATE</b> ladder diagrams and <b>CONNECT</b> manual control devices in the hands-on activity.*
Lesson 321 - Automatic Control Devices, Hands-On Activity*	
321.1	<b>RECOGNIZE</b> correct symbology and operation for automatic control devices (limit, pressure, temperature, float, flow, photocell, and time switches).
321.2	From the work description, <b>ILLUSTRATE</b> ladder diagrams and <b>CONNECT</b> automatic control devices in the hands-on activity.*
Lesson 322 - Relays, Solid-State Relays, Contactors, Hands-On Activities*	
322.1	<b>RECOGNIZE</b> and <b>EXPLAIN</b> the magnetic solenoid action required to operate magnetic control devices. <b>USE</b> correct solenoid symbology in ladder logic diagrams.
322.2	<b>RECOGNIZE</b> the purpose and function of contactors and relays. <b>SHOW</b> what happens to contacts when the coils are energized.
322.3	<b>IDENTIFY</b> the basic types of solid-state relays and indicate their characteristics in comparison to electromechanical relays.
322.4	From the work description, <b>ILLUSTRATE</b> ladder diagrams and <b>CONNECT</b> various contactors and relays in the hands-on activity.*
Lesson 323 - Holding Circuits, Hands-On Activities*	
323.1	<b>MASTER</b> the connection of holding circuits for relays and contactors.
323.2	From the work description, <b>ILLUSTRATE</b> ladder diagrams and <b>CONNECT</b> various scenarios with holding contacts in the hands-on activity.*

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## Lesson 324 - Timing Relays: On-Delay, Interval, and Recycle\*

- 324.1 **CONTRAST** timing relays with non-timing relays. **LIST** the types of timers available, identify timing modes, and recognize the symbols used for timing relay contacts in ladder diagrams.
- 324.2 **SELECT** and **ILLUSTRATE** the operation of on-delay timing relays.
- 324.3 **SELECT** and **ILLUSTRATE** the operation of interval and recycle (repeat) timing relays.
- 324.4 From the work description, **ILLUSTRATE** ladder diagrams and **CONNECT** various scenarios with 8-pin relays in the hands-on activity.\*

## Lesson 325 - Timing Relays: Off-Delay, One-Shot, and Multifunction; Hands-On Activities\*

- 325.1 **SELECT** and **ILLUSTRATE** the operation of off-delay timing relays.
- 325.2 **SELECT** and **ILLUSTRATE** the operation of one-shot timing relays.
- 325.3 **SELECT** and **ILLUSTRATE** the operation of multifunction timing relays.
- 325.4 From the work description, **ILLUSTRATE** ladder diagrams and **CONNECT** various scenarios with 11-pin relays in the hands-on activity.\*

## Lesson 326 - Ladder Logic Line Diagram: Critical Thinking Activity

- 326.1 **DEMONSTRATE** an understanding of control concepts and ladder logic line diagrams by creating and explaining a control circuit scenario.

## Lesson 327 - Midterm Review and Exam

- 327 This lesson will determine your proficiency in the subject matter of previous lessons.

## Lesson 328 - Magnetic Motor Starters, Control Circuit Overview, Hands-On Activity\*

- 328.1 **RECOGNIZE** the purpose and function of motor starters.
- 328.2 **LABEL** connection terminals on motor starters. **MASTER** connection of motor starters to control circuitry. **SHOW** what happens to contacts when the coils are energized.
- 328.3 **RECALL** the purpose and function of motor overloads.
- 328.4 **IDENTIFY** motor starter components (hands-on activity).\*

## Lesson 329 - Motor Power Connections, NEMA Enclosures, Hands-On Activity\*

- 329.1 **DEMONSTRATE** motor power connections as required for the available circuit voltage.
- 329.2 **REVIEW** NEMA enclosure classifications as they apply to environmental conditions.
- 329.3 From the work description, **ILLUSTRATE** ladder diagrams and **CONNECT** magnetic motor starters in the hands-on activity.\*

## Lesson 330 - Motor Reversing: Controllers and Connections, Hands-On Activity\*

- 330.1 **DESCRIBE** and **USE** manual methods to reverse the rotation of a three-phase motor.
- 330.2 **DESCRIBE** and **USE** magnetic motor starters to reverse the rotation of a three-phase motor.
- 330.3 From the work description, **ILLUSTRATE** ladder diagrams and **CONNECT** a reversing magnetic motor in the hands-on activity.\*

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## Lesson 331 - Jogging Circuits, Latching Relays, Alternating Relays, Phase-Loss Relays; Hands-On Activity\*

- 331.1 **DESCRIBE** the operation and function of jogging circuits.
- 331.2 **DESCRIBE** the operation and function of latching relays.
- 331.3 **DESCRIBE** the operation and function of alternating relays.
- 331.4 **INDICATE** the effects of phase loss on a motor. **DESCRIBE** the operation and function of a phase-loss relay.
- 331.5 From the work description, **ILLUSTRATE** ladder diagrams and **CONNECT** jogging circuits, latching relays, alternating relays, or phase-loss relays in the hands-on activity.\*

## Lesson 332 - Introduction to Limited Energy/Low-Voltage Systems

- 332.1 **RECOGNIZE** and **EXPLAIN** the basic functions of a structured cabling system as it relates to limited energy / low-voltage systems.
- 332.2 **RECOGNIZE** and **EXPLAIN** types of twisted pair structured cable (UTP), connectors, terminal blocks, terminations, and applications such as POE.
- 332.3 **RECOGNIZE** and **EXPLAIN** types of coaxial cable, connectors, and terminations.
- 332.4 **RECOGNIZE** and **EXPLAIN** types of fiber, fiber connectors, and terminations.

## Lesson 333 - Building the Foundation of the Productive Worker

- 333.1 **RECOGNIZE** types of motivation.
- 333.2 **LIST** elements of planning skills.
- 333.3 **DESCRIBE** key elements of organization.
- 333.4 **IDENTIFY** ways to increase personal productivity.

## Lesson 334 - Transition to Supervisor

- 334.1 **IDENTIFY** motivation types as they apply to supervision.
- 334.2 **OUTLINE** steps in task planning.
- 334.3 **LIST** key elements of organization.
- 334.4 **IDENTIFY** key concepts of productivity.

## Lesson 335 - Final Exam Review

- 335 This lesson will determine your proficiency in the subject matter from the previous lessons.

## Lesson 336 - Final Exam

- 336 This lesson will determine your proficiency in the subject matter from the previous lessons.

\* Additional resources may be found in the back of the book and/or CMS.

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comprehensive list of lesson objectives.**

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Fourth Year	
Lesson 401 - Energized Electrical Work Relative to NFPA 70E®	
401.1	<b>DEMONSTRATE</b> a broad understanding on working on or near energized electrical equipment as explained by OSHA and NFPA 70E®.
Lesson 402 - Introduction to Programmable Logic Controllers and Relays*	
402.1	<b>DEFINE</b> different types of programmable controllers.
402.2	<b>CONTRAST</b> programmable logic relays (PLRs) to traditional mechanical controls.
402.3	<b>DEMONSTRATE</b> a hands-on activity related to programmable logic relays (PLRs).
Lesson 403 - Introduction to Programming PLRs*	
403.1	<b>DESCRIBE</b> programming symbols, language, and force and disable commands. <b>USE</b> basic programming symbols and logic functions.
403.2	<b>DEMONSTRATE</b> a hands-on activity related to programmable logic relays (PLRs).
Lesson 404 - Variable Frequency Drives (VFDs): Motor Starting Methods, Accelerate/Decelerate*	
404.1	<b>UNDERSTAND</b> industry abbreviations and definitions related to variable frequency drives (VFDs). <b>DEFINE</b> the basic anatomy of a VFD.
404.2	<b>REVIEW</b> VFD motor starting concepts for acceleration and deceleration. <b>COMPARE</b> advantages and disadvantages of using VFDs over other motor control methods.
404.3	<b>LIST</b> and <b>EXPLAIN</b> the next career moves for someone interested in specializing in variable frequency drives (VFDs).
404.4	<b>DEMONSTRATE</b> a hands-on activity related to variable frequency drives (VFDs).
Lesson 405 - Power Quality	
405.1	<b>UNDERSTAND</b> industry abbreviations and definitions related to power quality.
405.2	<b>REVIEW</b> power quality and power distribution concepts.
405.3	<b>DESCRIBE</b> various standards and career paths.
Lesson 406 - Introduction to Solar Photovoltaics*	
406.1	<b>UNDERSTAND</b> industry abbreviations and definitions related to photovoltaic systems.
406.2	<b>DESCRIBE</b> and apply the basic functions of a photovoltaic system.
406.3	<b>LIST</b> and <b>EXPLAIN</b> the next career moves for someone interested in specializing in photovoltaic systems.
406.4	<b>DEMONSTRATE</b> a hands-on activity related to photovoltaic systems.
Lesson 407 - Introduction to Electric Vehicles and Electric Vehicle Charging Stations	
407.1	<b>COMPARE</b> electric vehicle (EV) types and understand the differences between them.
407.2	<b>COMPARE</b> EV charger types and understand the differences between them.
407.3	<b>COMPARE</b> energy storage systems and understand the differences between them.
407.4	<b>REVIEW</b> NEC® requirements for EV charging systems.
Lesson 408 - Introduction to Supervision	
408.1	<b>DEFINE</b> a supervisor and <b>RECOGNIZE</b> characteristics that will help a production worker transition to a supervisor.
408.2	<b>LIST</b> skills of a supervisor and <b>DESCRIBE</b> how to cultivate and improve these skills.
408.3	<b>RECOGNIZE</b> the value of good supervision and why it is important for your company and to your career.
408.4	<b>LIST</b> job titles that require supervision skills and where to find additional training.
Lesson 409 - Midterm Review and Exam	
409	This lesson will determine your proficiency in the subject matter from the previous lessons.



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Lesson 410 - Introduction to Limited Energy Systems, Structured Cabling*	
410.1	<b>INTERPRET</b> industry abbreviations and definitions related to Limited Energy/Low Voltage Systems. <b>RECOGNIZE</b> tools used for low voltage installations.
410.2	<b>DESCRIBE</b> and apply the basic functions of a structured cabling system.
410.3	<b>LIST</b> and <b>EXPLAIN</b> the next career moves for someone interested in specializing in structured cabling.
410.4	<b>DEMONSTRATE</b> a hands-on activity related to structured cabling.
Lesson 411 - Home Automation, Audio/Sound Systems, and Video Surveillance Systems	
411.1	<b>DEFINE</b> industry abbreviations and definitions related to home automation, audio/sound systems, and video surveillance systems.
411.2	<b>DESCRIBE</b> and apply the basic functions of a home automation system, an audio/sound system, and a video surveillance system.
411.3	<b>LIST</b> and <b>EXPLAIN</b> the next career moves for someone interested in specializing in home automation, audio/sound systems, or video surveillance systems.
Lesson 412 - PoE and Lighting Systems*	
412.1	<b>DEFINE</b> industry abbreviations and definitions related to PoE and Lighting Systems.
412.2	<b>RECOGNIZE</b> the various components of a lighting system. Understand the role PoE plays in lighting and lighting controls.
412.3	<b>LIST</b> and <b>EXPLAIN</b> the next career moves for someone interested in lighting systems.
412.4	<b>DEMONSTRATE</b> a hands-on activity related to PoE and lighting systems.
Lesson 413 - Introduction to Building Automation Systems (BAS)	
413.1	<b>DEFINE</b> industry abbreviations and definitions related to building automation systems.
413.2	<b>DESCRIBE</b> and <b>APPLY</b> the basic functions of a building automation system.
413.3	<b>LIST</b> and <b>EXPLAIN</b> the next career moves for someone interested in building automation systems.
Lesson 414 - Fire Alarm Systems*	
414.1	<b>DEFINE</b> industry abbreviations and definitions related to fire alarm systems.
414.2	<b>DESCRIBE</b> and apply the basic functions of a fire alarm system.
414.3	<b>LIST</b> and <b>EXPLAIN</b> the next career moves for someone interested in specializing in fire alarm systems.
414.4	<b>DEMONSTRATE</b> a hands-on activity related to fire alarm systems.
Lesson 415 - Predictive and Preventive Maintenance	
415.1	<b>DEFINE</b> industry abbreviations and definitions related to predictive and preventive maintenance.
415.2	<b>DESCRIBE</b> the differences between predictive and preventive maintenance. <b>IDENTIFY</b> the methods used to conduct predictive and preventive maintenance.
415.3	<b>LIST</b> and <b>EXPLAIN</b> the next career moves for someone interested in predictive and preventive maintenance.
Lesson 416 - Troubleshooting*	
416.1	<b>DEFINE</b> the troubleshooting process.
416.2	<b>PERFORM</b> the process of troubleshooting.
Lesson 417 - First Semester Final Exam Review	
417	This lesson will provide a review of the subject matter from previous lessons.
Lesson 418 - First Semester Final Exam	
418	This lesson will determine your proficiency in the subject matter from previous lessons.

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Lesson 419 - Using and Applying NEC® 90, 100, and 110	
419.1	<b>POSSESS</b> an understanding of the creation, format, structure, and practical application of the <i>National Electrical Code</i> ® (NEC®). <b>IDENTIFY</b> the scope, purpose, arrangement, and enforcement of the NEC® as contained in NEC 90®.
419.2	<b>RECALL</b> definitions of electrical terms and equipment in order to adequately prepare for the study, interpretation, and application of NEC® Article 100.
419.3	<b>RECALL</b> the requirements for electrical installations of equipment and conductors according to Article 110 of the NEC®.
419.4	<b>RECOGNIZE</b> voltages and properties of various electrical systems.
Lesson 420 - Branch Circuits and Feeders, NEC® 210 and 215	
420.1	<b>RECALL</b> branch circuit requirements as contained in NEC® Article 210 regarding GFCI and AFCI protection and branch circuit ratings.
420.2	<b>RECALL</b> required branch circuits and required outlets found in NEC® Article 210.
420.3	<b>RECALL</b> feeder requirements as contained in NEC® Article 215.
Lesson 421 - Load Calculations, NEC® 220—Part 1	
421.1	<b>REVIEW</b> NEC® requirements for branch circuit calculations.
421.2	<b>REVIEW</b> NEC® requirements for electric cooking appliance calculations.
421.3	<b>REVIEW</b> NEC® requirements for standard feeder and service load calculations for a dwelling.
Lesson 422 - Load Calculations, NEC® 220—Part 2	
422.1	<b>REVIEW</b> NEC® requirements for standard feeder and service load calculations for a multifamily dwelling.
422.2	<b>REVIEW</b> NEC® requirements for optional feeder and service load calculations.
422.3	<b>REVIEW</b> NEC® requirements for commercial feeder and service load calculations.
Lesson 423 - Services, NEC® 230	
423.1	<b>IDENTIFY</b> the key components for electrical services.
423.2	<b>POSSESS</b> a fundamental understanding of the clearances and other requirements for overhead services.
423.3	<b>POSSESS</b> a fundamental understanding of the clearances and other requirements for underground services.
423.4	<b>IDENTIFY</b> the requirements for service equipment.
Lesson 424 - Conductors and Overcurrent, NEC® 100, 110, 240, 310	
424.1	<b>POSSESS</b> a fundamental understanding of ampacity, termination, insulation ratings, ambient temperature, and other adjustment factors of circuit conductors.
424.2	<b>MASTER</b> the purpose and the selection of fuses and circuit breakers for the protection of conductors and equipment.
424.3	<b>IDENTIFY</b> the characteristics of branch circuits, feeders, and taps.
424.4	<b>INDICATE</b> practical application of OCPDs.
Lesson 425 - Grounding, NEC® 250	
425.1	<b>IDENTIFY</b> grounding terminology and functionality.
425.2	<b>MASTER</b> the installation and sizing of the main bonding or system bonding jumper.
425.3	<b>MASTER</b> the installation of grounding electrodes and the sizing of grounding electrode conductors.
425.4	<b>MASTER</b> the purpose, installation, and sizing of equipment grounding conductors.

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Lesson 426 - Wiring Methods, NEC® Chapter 3	
426.1	<b>REVIEW</b> the general requirements and installation practices for all wiring methods as described in NEC® Article 300.
426.2	<b>RECALL</b> properties and NEC® requirements for various cables, raceways, and other wiring methods.
426.3	<b>REVIEW</b> calculations for sizing raceways and wireways.
426.4	<b>REVIEW</b> calculations for sizing outlet device and junction boxes.
426.5	<b>REVIEW</b> calculations for sizing pull boxes containing 4 AWG or larger.
Lesson 427 - Midterm Review and Exam	
427	This lesson will determine your proficiency in the subject matter from the previous lessons.
Lesson 428 - Switches, Switchgear, Panelboard, NEC® 404 and 408	
428.1	<b>MASTER</b> general requirements for switches as per NEC® 404.
428.2	<b>RECOGNIZE</b> characteristics of switchboards and panelboard as per NEC® 408.
Lesson 429 - Equipment for General Use, NEC® 400, 406, 410, and 422	
429.1	<b>REVIEW</b> the rating, installation, and overcurrent protection requirements for flexible cords.
429.2	<b>REVIEW</b> the type, grounding, and installation requirements for receptacles, cord connectors, and attachment plugs.
429.3	<b>REVIEW</b> the location, support, grounding, and installation requirements for luminaires.
429.4	<b>REVIEW</b> the branch circuit ratings, overcurrent protection, disconnecting means, markings, and installation requirements for appliances.
Lesson 430 - Equipment for General Use, NEC® 430, 440, 445, and 695	
430.1	<b>REVIEW</b> motors, motor circuits, and motor controllers.
430.2	<b>REVIEW</b> air conditioning and refrigeration equipment.
430.3	<b>REVIEW</b> generators.
430.4	<b>REVIEW</b> fire pump requirements.
Lesson 431 - Transformers, NEC® 450	
431.1	<b>RECALL</b> various types of transformers and their construction.
431.2	<b>IDENTIFY</b> NEC® and manufacturer's transformer installation requirements.
431.3	<b>IDENTIFY</b> NEC® requirements for transformer vaults.
431.4	<b>MASTER</b> the NEC® requirements for the protection of transformers and primary conductors against overcurrent.
431.5	<b>MASTER</b> the NEC® requirements for the protection of transformer secondary conductors (taps) against overcurrent.
Lesson 432 - Special Locations: NEC® 500-504, 511, 514, 517, and 590	
432.1	<b>IDENTIFY</b> NEC® requirements for hazardous locations and their classifications.
432.2	<b>IDENTIFY</b> NEC® requirements for commercial garages and motor fuel dispensing facilities.
432.3	<b>IDENTIFY</b> NEC® requirements for health care facilities.
432.4	<b>IDENTIFY</b> NEC® requirements for temporary installations.

Lesson 433 - Renewable Energy: NEC® 625, 690, 691, 694, 705, and 706

- 433.1 **REVIEW** NEC® requirements for electric vehicle power transfer systems.
- 433.2 **REVIEW** NEC® requirements for solar photovoltaic systems.
- 433.3 **REVIEW** NEC® requirements for wind electric systems.
- 433.4 **REVIEW** NEC® requirements for interconnected electric power production sources.
- 433.5 **REVIEW** NEC® requirements for energy storage systems.

Lesson 434 - Electrical License Exam Preparation

- 434.1 **UNDERSTAND** how to prepare to take an electrical licensing exam.
- 434.2 **DEMONSTRATE** trade knowledge and use of the NEC® in a practice licensing exam.

Lesson 435 - Second Semester Final Exam Review

- 435 This lesson will provide a review of the subject matter from previous lessons.

Lesson 436 - Second Semester Final Exam

- 436 This lesson will determine your proficiency in the subject matter from previous lessons.

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