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First Year	
Lesson 101 - Orientation and Basic Principles	
101.1	**DESCRIBE** and **EXPLAIN** the IEC four-year electrical apprenticeship program.
101.2	**LIST** and **EXPLAIN** the advantages of the merit shop philosophy within the IEC apprenticeship program.
101.3	**DESCRIBE** and **EXPLAIN** the apprenticeship policies and procedures of the IEC chapter sponsoring your training program.
101.4	**DESCRIBE** what it means to be a professional in the electrical field.
101.5	**LIST** possible career paths in the electrical field.
101.6	**DESCRIBE** basic electrical terms and common voltages.
Lesson 102 - Introduction to Construction Safety, Electrical Test Instruments, and Applied Electrical Math	
102.1	**RECOGNIZE** requirements of construction safety.
102.2	**RECOGNIZE** and **IDENTIFY** electrical test instruments.
102.3	**MASTER** applied electrical math including reciprocals, fractions, percents, area, volume, and conversions.
102.4	**CALCULATE** the cost of electricity.
Lesson 103 - Tools and Fasteners	
103.1	**RECOGNIZE** hand tools used in the trade by identifying the “dos and don’ts” of their use and care. **DESCRIBE** torque wrenches and their use.
103.2	**RECOGNIZE** power tools used in the trade by identifying the “dos and don’ts” of their use and care.
103.3	**RECOGNIZE** and **IDENTIFY** construction fasteners.
Lesson 104 - Introduction to Electrical Theory and Ohm’s Law	
104.1	**UNDERSTAND** basic electron theory.
104.2	**RECOGNIZE** characteristics of electrical circuits and current flow.
104.3	**RECOGNIZE** the relationship between voltage, current, resistance, and power as demonstrated in Ohm’s Law.
104.4	**COMPARE** and **CONTRAST** results of using different applied voltages as demonstrated in Ohm’s Law.
Lesson 105 - Introduction to Navigating the *National Electrical Code*®	
105.1	**EXPLAIN** the intent and layout of the *National Electrical Code*® (NEC®).
105.2	**UNDERSTAND** how to navigate the NEC®.
105.3	**IDENTIFY** the scope, purpose, arrangement, and enforcement of the NEC® as contained in Article 90.
105.4	**DISCUSS** definitions of electrical terms as contained in Article 100.
Lesson 106 - Conduits and Raceways	
106.1	**DISCUSS** the NEC® requirements for conduits and raceways.
106.2	**IDENTIFY** fittings and supports associated with conduit and raceways.
106.3	**SELECT** proper conduit size by using Tables 4 and 5 in the NEC®.
Lesson 107 - Conductors	
107.1	**IDENTIFY** and **DISCUSS** conductor material and construction.
107.2	**IDENTIFY** and **DISCUSS** conductor insulation and uses.
107.3	**LIST** and **DESCRIBE** termination types and ratings.
107.4	**IDENTIFY** and **DISCUSS** conductor ampacity.
107.5	**CALCULATE** voltage drop on a conductor.

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Lesson 108 - Cables and Cords	
108.1	**IDENTIFY** the difference between cable assemblies and flexible cords.
108.2	**DISCUSS** the NEC® requirements for cable assemblies used as wiring methods.
108.3	**DISCUSS** the NEC® requirements for flexible cords.
108.4	**IDENTIFY** fittings and supports associated with cable assemblies and flexible cords.
Lesson 109 - First Semester Midterm Review and Exam	
109	This lesson will determine your proficiency in the subject matter from the previous lessons.
Lesson 110 - General Requirements for Wiring Methods and Introduction to Conduit Bending	
110.1	**DESCRIBE** NEC® general requirements for wiring methods and materials.
110.2	**DESCRIBE** NEC® requirements for underground installations.
110.3	**OUTLINE** mathematical calculations and **APPLY** them to conduit bending.
Lesson 111 - Conduit Bending Application	
111.1	**REVIEW** mathematical calculations and **APPLY** them to bending conduit.
111.2	**DEMONSTRATE** EMT conduit bending hands-on activity.
111.3	**DESCRIBE** bending other types of conduits.
Lesson 112 - Boxes and Enclosures	
112.1	**IDENTIFY** the difference between electrical boxes and enclosures.
112.2	**DISCUSS** box types, supports, and accessories.
112.3	**DISCUSS** the NEC® requirements for box fill per Section 314.16.
Lesson 113 - Receptacles	
113.1	**IDENTIFY** receptacle types.
113.2	**DESCRIBE** the installation and operation of AFCI and GFCI receptacles.
113.3	**LIST** the NEC® requirements for receptacle installation.
Lesson 114 - Snap Switches	
114.1	**RECOGNIZE** the construction, operation, and connection of switches.
114.2	**DESCRIBE** the NEC® requirements for switches.
114.3	**RECOGNIZE** the expected voltmeter measurements across open and closed switches.

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Lesson 115 - Lighting and Luminaires	
115.1	**DESCRIBE** the fundamentals of lighting.
115.2	**LIST** and **DESCRIBE** luminaire types and lighting terminology.
115.3	**DISCUSS** NEC® and building code requirements for luminaires.
Lesson 116 - Introduction to Printreading	
116.1	**IDENTIFY** symbols, scales, notes, and schedules found on construction drawings.
116.2	**DISCUSS** circuit layout used with construction drawings.
116.3	**DISCUSS** the coordination of electrical installations with other trades.
Lesson 117 - First Semester Final Exam Review	
117	This lesson will determine your proficiency in the subject matter from the previous lessons.
Lesson 118 - First Semester Final Exam	
118	This lesson will determine your proficiency in the subject matter from the previous lessons.
Lesson 119 - Conductor Ampacity and Adjustment Factors	
119.1	**RECALL** properties and ampacities of insulated conductors.
119.2	**DESCRIBE** adjustment factors of conductors.
119.3	**RECALL** temperature limitations found in NEC® Section 110.14.
119.4	**DESCRIBE** NEC® requirements for conductors installed in parallel.
Lesson 120 - Series Circuits	
120.1	**DEFINE** and **IDENTIFY** properties of series circuitry.
120.2	**CALCULATE** unknowns in a series circuit when given known values.
120.3	**RECOGNIZE** and **SOLVE** various single-phase voltage drop calculations using the resistance method.
Lesson 121 - Parallel Circuits	
121.1	**DEFINE** and **IDENTIFY** properties of parallel circuitry.
121.2	**CALCULATE** parallel circuit values by using various methods.

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Lesson 122 - Series/Parallel Circuits	
122.1	**DEFINE** and **IDENTIFY** properties of series/parallel circuitry.
122.2	**CALCULATE** series/parallel circuit values.
Lesson 123 - Branch Circuits Part I	
123.1	**DISCUSS** NEC® definitions for branch circuits.
123.2	**DESCRIBE** NEC® required branch circuits for dwelling units.
123.3	**DESCRIBE** NEC® required receptacle outlets for dwelling units.
Lesson 124 - Branch Circuits Part II	
124.1	**DESCRIBE** NEC® requirements for GFCI-protected branch circuits in dwelling units.
124.2	**DESCRIBE** NEC® requirements for AFCI-protected branch circuits in dwelling units.
124.3	**DESCRIBE** NEC® required lighting outlets.
124.4	**OUTLINE** NEC® requirements for branch circuit load calculations, including minimum branch circuits in dwellings.
Lesson 125 - Multiwire Branch Circuits	
125.1	**DESCRIBE** NEC® requirements for multiwire branch circuits.
125.2	**CALCULATE** watt loss, voltage drop, and current flow in two- and three-wire circuits. **EXPLAIN** how series, parallel, and combination circuits relate to multiwire branch circuits.
125.3	**DISCUSS** the impact of an open neutral on the connected loads of a multiwire branch circuit.
Lesson 126 - Overcurrent Protection	
126.1	**RECOGNIZE** basic overcurrent device types, terminology, and operation.
126.2	**DISCUSS** NEC® requirements for ratings, sizing, and installation of overcurrent protective devices (OCPDs).
126.3	**RECOGNIZE** possible circuit conditions (normal, short-circuit, overload, open, ground-fault).
Lesson 127 - Second Semester Midterm Review and Exam	
127	This lesson will determine your proficiency in the subject matter from the previous lessons.
Lesson 128 - Introduction to Power Generation	
128.1	**LIST** and **DESCRIBE** power generation sources.
128.2	**DESCRIBE** components of standby systems.
128.3	**DESCRIBE** components of renewable power sources.
128.4	**DESCRIBE** components of energy storage systems.
Lesson 129 - Introduction to Services and Service Equipment	
129.1	**RECOGNIZE** the NEC® terminology and requirements for electrical service installations.
129.2	**RECOGNIZE** NEC® requirements for working space about electrical equipment.

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Lesson 130 - Effective Ground Fault Path	
130.1	**RECOGNIZE** the NEC® terminology and general requirements for grounding and bonding.
130.2	**RECOGNIZE** NEC® requirements of the equipment grounding conductor.
Lesson 131 - Appliances and Equipment	
131.1	**RECOGNIZE** NEC® requirements for appliances and equipment.
131.2	**DEFINE** NEC® requirements for disconnecting means for appliances and equipment.
131.3	**DEFINE** NEC® requirements for grounding appliances and equipment.
Lesson 132 - Heating and Air-Conditioning	
132.1	**LIST** and **DESCRIBE** different types of heating and air-conditioning equipment.
132.2	**RECOGNIZE** NEC® requirements for heating and air-conditioning equipment.
132.3	**DEFINE** NEC® requirements for disconnecting means for heating and air-conditioning equipment.
132.4	**DESCRIBE** the difference between control circuits and power circuits.
Lesson 133 - Swimming Pools, Hydromassage Tubs, and Spas	
133.1	**RECOGNIZE** electrical hazards associated with swimming pools, hydromassage tubs, and spas.
133.2	**DESCRIBE** NEC® requirements for swimming pools, hydromassage tubs, and spas.
133.3	**DESCRIBE** NEC® requirements for equipotential bonding of swimming pools.
Lesson 134 - Communication and Special Systems	
134.1	**LIST** and **DESCRIBE** communication and special system cables.
134.2	**LIST** and **DESCRIBE** communication and special system components.
134.3	**DESCRIBE** NEC® requirements for Class 1–4 wiring.
134.4	**LIST** and **DESCRIBE** applications for communication and special systems cabling.
Lesson 135 - Second Semester Final Exam Review	
135	This lesson will determine your proficiency in the subject matter from the previous lessons.
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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Second Year	
Abbreviations and Special Notes and General Application Notes	
Lesson 201 - Construction Materials	
201.1	**RECOGNIZE** structural supports. **DESCRIBE** the uses of steel and metal in construction.
201.2	**IDENTIFY** wood construction materials. **DESCRIBE** wood framing types and methods.
201.3	**DESCRIBE** foundation types and foundation assembly methods.
201.4	**DESCRIBE** masonry types and masonry methods.
201.5	**RECOGNIZE** insulation, wall coverings, finishes, and firestopping methods.
Lesson 202 - Printreading: Project Design, Development, and Specifications*	
202.1	**DESCRIBE** project origins and construction professionals.
202.2	**INTERPRET** the purpose and format of specifications.*
202.3	**INTERPRET** specifications for the Wendy's restaurant project—Documentation.
202.4	**INTERPRET** specifications for the Wendy's restaurant project—Construction.
Lesson 203 - Printreading Basics	
203.1	**RECOGNIZE** and distinguish different prints: title page, civil, structural, architectural, electrical, mechanical, etc.
203.2	**INTERPRET** general notes, key notes, abbreviations, and symbols.
203.3	**RECOGNIZE** and **IDENTIFY** project plan lines, scales, and dimensions.
203.4	**RECOGNIZE** and distinguish different drawings: elevations, section drawings, detail drawings, and schedules.
Lesson 204 - Electrical Part I: Service, Distribution, and Panel Schedules	
204.1	**INTERPRET** and **LIST** electrical materials and methods.
204.2	**RECOGNIZE** electrical service and distribution components.
204.3	**INTERPRET** electrical panel schedules.
Lesson 205 - Electrical Part II: Lighting, Power, and Other Associated Drawings	
205.1	**INTERPRET** electrical lighting drawings.
205.2	**INTERPRET** electrical power drawings.
205.3	**INTERPRET** fire-alarm, communications, controls, and security systems.
205.4	**INTERPRET** electrical quantity take-off.
Lesson 206 - Site/Civil and Structural Drawings	
206.1	**LOCATE** and **USE** site, civil, and survey drawings.
206.2	**INTERPRET** foundation and structural floor plans.
206.3	**INTERPRET** 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 - First Semester 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, 120, 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 120.
210.5	**IDENTIFY** examples in NEC® Informative Annex D and how they relate to Article 120.
210.6	**IDENTIFY** key concepts and key words in NEC® Article 200.
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, 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 225.
212.3	**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 320–392*	
216.1	**IDENTIFY** code organization and structure standards as contained in NEC® Articles 320–392.
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 366–392.
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 - Second Semester 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, wiring devices, 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 - Second Semester Final Exam Review	
235	This lesson will provide a review of the subject matter from previous lessons.
Lesson 236 - Second Semester Final Exam	
236	This lesson will determine your proficiency in the subject matter from previous lessons.

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Third Year	
Lesson 301 - Test Instruments, OSHA, NFPA 70E®, and Test Instrument Safety	
301.1	**USE** and correctly **INTERPRET** information on a digital meter display. List examples of electrical test instruments and demonstrate their uses.
301.2	**RECALL** the important key safety requirements relative to OSHA and NFPA 70E®.
301.3	**DEMONSTRATE** safe test instrument habits by using proper PPE and procedures.
Lesson 302 - Introduction to Grounding and Bonding; General Requirements	
302.1	**REVIEW** definitions for grounding and bonding.
302.2	**IDENTIFY** the components and explain the effective ground-fault path to facilitate the OCPD operation.
302.3	**IDENTIFY** 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	**REVIEW** 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	**EXPLAIN** a separately derived system.
303.3	**REVIEW** the various common AC voltage systems. Determine which systems and branch circuits are not required or are not permitted to be grounded.
303.4	**DESCRIBE** and **EXPLAIN** installation requirements and properly sized grounded conductors.
Lesson 304 - System Grounding: Separately Derived Systems, Main Bonding Jumpers, and System Bonding Jumpers*	
304.1	**RECALL** and **EXPLAIN** the function, installation requirements, and sizing of main and system bonding jumpers.*
304.2	**ASSESS** grounding and installation requirements for separately derived systems.
304.3	**ASSESS** the grounding requirements for two or more buildings or structures supplied by feeders or branch circuits.
304.4	**ASSESS** the grounding requirements for portable and vehicle-mounted generators and impedance grounded systems.
Lesson 305 - Grounding Electrode Systems and Grounding Electrode Conductors*	
305.1	**EXPLAIN** general requirements for the grounding electrode system. **CHOOSE** which types of electrodes are permitted and the correct installation of the electrodes.
305.2	**REVIEW** requirements for grounding electrode conductors.*
305.3	**REVIEW** sizing for grounding electrode conductors.
Lesson 306 - Supply-Side and Load-Side Bonding Jumpers	
306.1	**DEMONSTRATE** the requirements for supply-side bonding jumpers including materials used, installation, and sizing.
306.2	**DEMONSTRATE** the requirements for load-side bonding jumpers including materials used, installation, and sizing.
Lesson 307 - Equipment Grounding and Equipment Grounding Conductors	
307.1	**IDENTIFY** effective equipment grounding and recognize the difference between short circuit and ground fault.
307.2	**REVIEW** grounding requirements for fastened-in-place equipment.
307.3	**REVIEW** 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 - First Semester 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	**DESCRIBE** adjustable-speed drive system technology and **CONTRAST** it to traditional motor circuitry.
315.2	**DESCRIBE** and **APPLY** speed control methods for various classifications of motor loads.
Lesson 316 - AC Equipment, Fire Pumps	
316.1	**FORMULATE** the minimum size for conductors, safety switches, and OCPDs used for air conditioning and refrigeration equipment branch circuits.
316.2	**RECOGNIZE** the NEC® requirements for fire pumps.
Lesson 317 - First Semester Final Exam Review	
317	This lesson will provide a review of the subject matter from previous lessons.
Lesson 318 - First Semester Final Exam	
318	This lesson will determine your proficiency in the subject matter from previous lessons.
Lesson 319 - Introduction to Ladder Logic, Pushbuttons	
319.1	**RECOGNIZE** inputs and outputs. **LABEL** various switches and loads as input or output.
319.2	**RECOGNIZE** correct symbology and operation for toggle switches, pushbuttons, and basic loads.
319.3	**WRITE** simple ladder diagrams. **LABEL** ladder diagrams.
Lesson 320 - Manual Control Devices, Hands-On Activity*	
320.1	**RECOGNIZE** correct symbology and operation for manual control devices (pushbuttons, selector switches, joysticks, and foot switches).
320.2	From the work description, **ILLUSTRATE** ladder diagrams and **CONNECT** manual control devices in the hands-on activity.*
Lesson 321 - Automatic Control Devices, Hands-On Activity*	
321.1	**RECOGNIZE** correct symbology and operation for automatic control devices (limit, pressure, temperature, float, flow, photocell, and time switches).
321.2	From the work description, **ILLUSTRATE** ladder diagrams and **CONNECT** automatic control devices in the hands-on activity.*
Lesson 322 - Relays, Solid-State Relays, Contactors, Hands-On Activities*	
322.1	**RECOGNIZE** and **EXPLAIN** the magnetic solenoid action required to operate magnetic control devices. **USE** correct solenoid symbology in ladder logic diagrams.
322.2	**RECOGNIZE** the purpose and function of contactors and relays. **SHOW** what happens to contacts when the coils are energized.
322.3	**IDENTIFY** the basic types of solid-state relays and indicate their characteristics in comparison to electromechanical relays.
322.4	From the work description, **ILLUSTRATE** ladder diagrams and **CONNECT** various contactors and relays in the hands-on activity.*
Lesson 323 - Holding Circuits, Hands-On Activities*	
323.1	**MASTER** the connection of holding circuits for relays and contactors.
323.2	From the work description, **ILLUSTRATE** ladder diagrams and **CONNECT** 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 - Second Semester 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 electrical circuitry. **SHOW** what happens to contacts (holding, auxiliary) when the coils are energized.
328.3	**RECALL** the purpose and function of motor overloads.
328.4	**IDENTIFY** motor starter components in the 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 - Second Semester Final Exam Review	
335	This lesson will provide a review of the subject matter from the previous lessons.
Lesson 336 - Second Semester Final Exam	
336	This lesson will determine your proficiency in the subject matter from the previous lessons.

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Lesson 401 - Energized Electrical Work Relative to NFPA 70E®	
401.1	**DEMONSTRATE** 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	**DEFINE** different types of programmable controllers.
402.2	**CONTRAST** programmable logic relays (PLRs) to traditional mechanical controls.
402.3	**DEMONSTRATE** a hands-on activity related to programmable logic relays (PLRs).
Lesson 403 - Introduction to Programming PLRs*	
403.1	**DESCRIBE** programming symbols, language, and force and disable commands. **USE** basic programming symbols and logic functions.
403.2	**DEMONSTRATE** a hands-on activity related to programmable logic relays (PLRs).
Lesson 404 - Variable Frequency Drives (VFDs): Motor Starting Methods, Accelerate/Decelerate*	
404.1	**UNDERSTAND** industry abbreviations and definitions related to variable frequency drives (VFDs). **DEFINE** the basic anatomy of a VFD.
404.2	**REVIEW** VFD motor starting concepts for acceleration and deceleration. **COMPARE** advantages and disadvantages of using VFDs over other motor control methods.
404.3	**LIST** and **EXPLAIN** the next career moves for someone interested in specializing in variable frequency drives (VFDs).
404.4	**DEMONSTRATE** a hands-on activity related to variable frequency drives (VFDs).
Lesson 405 - Power Quality	
405.1	**UNDERSTAND** industry abbreviations and definitions related to power quality.
405.2	**REVIEW** power quality and power distribution concepts.
405.3	**DESCRIBE** various standards and career paths.
Lesson 406 - Introduction to Solar Photovoltaics*	
406.1	**UNDERSTAND** industry abbreviations and definitions related to photovoltaic systems.
406.2	**DESCRIBE** and apply the basic functions of a photovoltaic system.
406.3	**LIST** and **EXPLAIN** the next career moves for someone interested in specializing in photovoltaic systems.
406.4	**DEMONSTRATE** a hands-on activity related to photovoltaic systems.
Lesson 407 - Introduction to Electric Vehicles, Electric Vehicle Chargers, and Energy Storage	
407.1	**COMPARE** electric vehicle (EV) types and **UNDERSTAND** the differences between them.
407.2	**COMPARE** EV charger types and **UNDERSTAND** the differences between them.
407.3	**COMPARE** energy storage systems and **UNDERSTAND** the differences between them.
407.4	**REVIEW** NEC® requirements for EV charging systems.
Lesson 408 - Introduction to Supervision	
408.1	**DEFINE** a supervisor and **RECOGNIZE** characteristics that will help a production worker transition to a supervisor.
408.2	**LIST** skills of a supervisor and **DESCRIBE** how to cultivate and improve these skills.
408.3	**RECOGNIZE** the value of good supervision and why it is important for your company and to your career.
408.4	**LIST** job titles that require supervision skills and where to find additional training.
Lesson 409 - First Semester 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	**INTERPRET** industry abbreviations and definitions related to Limited Energy/Low Voltage Systems. **RECOGNIZE** tools used for low voltage installations.
410.2	**DESCRIBE** and **APPLY** the basic functions of a structured cabling system.
410.3	**LIST** and **EXPLAIN** the next career moves for someone interested in specializing in structured cabling.
410.4	**DEMONSTRATE** a hands-on activity related to structured cabling.
Lesson 411 - Home Automation	
411.1	**DEFINE** industry abbreviations and definitions related to home automation.
411.2	**DESCRIBE** and **APPLY** the basic functions of a home automation system.
411.3	**LIST** and **EXPLAIN** the next career moves for someone interested in specializing in home automation.
Lesson 412 - Audio/Sounds Systems and Video Surveillance Systems	
412.1	**DEFINE** industry abbreviations and definitions related to audio/sound systems and video surveillance systems.
412.2	**DESCRIBE** and **APPLY** the basic functions of audio/sound systems and video surveillance systems.
412.3	**LIST** and **EXPLAIN** the next career moves for someone interested in audio/sound systems and video surveillance systems.
Lesson 413 - Introduction to Building Automation Systems (BAS)	
413.1	**DEFINE** industry abbreviations and definitions related to building automation systems.
413.2	**DESCRIBE** and **APPLY** the basic functions of a building automation system.
413.3	**LIST** and **EXPLAIN** the next career moves for someone interested in building automation systems.
Lesson 414 - Fire Alarm Systems*	
414.1	**DEFINE** industry abbreviations and definitions related to fire alarm systems.
414.2	**DESCRIBE** and **APPLY** the basic functions of a fire alarm system.
414.3	**LIST** and **EXPLAIN** the next career moves for someone interested in specializing in fire alarm systems.
414.4	**DEMONSTRATE** a hands-on activity related to fire alarm systems.
Lesson 415 - Predictive and Preventive Maintenance	
415.1	**DEFINE** industry abbreviations and definitions related to predictive and preventive maintenance.
415.2	**DESCRIBE** the differences between predictive and preventive maintenance. **IDENTIFY** the methods used to conduct predictive and preventive maintenance.
415.3	**LIST** and **EXPLAIN** the next career moves for someone interested in predictive and preventive maintenance.
Lesson 416 - Troubleshooting*	
416.1	**DEFINE** the troubleshooting process.
416.2	**PERFORM** 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	**POSSESS** an understanding of the creation, format, structure, and practical application of the *National Electrical Code®* (NEC®). **IDENTIFY** the scope, purpose, arrangement, and enforcement of the NEC® as contained in NEC 90®.
419.2	**RECALL** definitions of electrical terms and equipment in order to adequately prepare for the study, interpretation, and application of NEC® Article 100.
419.3	**RECALL** the requirements for electrical installations of equipment and conductors according to Article 110 of the NEC®.
419.4	**RECOGNIZE** voltages and properties of various electrical systems.
Lesson 420 - Branch Circuits and Feeders, NEC® 210 and 215	
420.1	**RECALL** branch circuit requirements as contained in NEC® Article 210 regarding GFCI and AFCI protection and branch circuit ratings.
420.2	**RECALL** required branch circuits and required outlets found in NEC® Article 210.
420.3	**RECALL** feeder requirements as contained in NEC® Article 215.
Lesson 421 - Load Calculations, NEC® 120—Part 1	
421.1	**REVIEW** NEC® requirements for branch circuit calculations.
421.2	**REVIEW** NEC® requirements for electric cooking appliance calculations.
421.3	**REVIEW** NEC® requirements for standard feeder and service load calculations for a dwelling.
Lesson 422 - Load Calculations, NEC® 120—Part 2	
422.1	**REVIEW** NEC® requirements for standard feeder and service load calculations for a multifamily dwelling.
422.2	**REVIEW** NEC® requirements for optional feeder and service load calculations.
422.3	**REVIEW** NEC® requirements for commercial feeder and service load calculations.
Lesson 423 - Services, NEC® 230	
423.1	**IDENTIFY** the key components for electrical services.
423.2	**POSSESS** a fundamental understanding of the clearances and other requirements for overhead services.
423.3	**POSSESS** a fundamental understanding of the clearances and other requirements for underground services.
423.4	**IDENTIFY** the requirements for service equipment.
Lesson 424 - Conductors and Overcurrent, NEC® 100, 110, 240, 310	
424.1	**POSSESS** a fundamental understanding of ampacity, termination, insulation ratings, ambient temperature, and other adjustment factors of circuit conductors.
424.2	**MASTER** the purpose and the selection of fuses and circuit breakers for the protection of conductors and equipment.
424.3	**IDENTIFY** the characteristics of branch circuits, feeders, and taps.
424.4	**INDICATE** practical application of OCPDs.
Lesson 425 - Grounding, NEC® 250	
425.1	**IDENTIFY** grounding terminology and functionality.
425.2	**MASTER** the installation and sizing of the main bonding or system bonding jumper.
425.3	**MASTER** the installation of grounding electrodes and the sizing of grounding electrode conductors.
425.4	**MASTER** the purpose, installation, and sizing of equipment grounding conductors.

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Lesson 426 - Wiring Methods, NEC® Chapter 3	
426.1	**REVIEW** the general requirements and installation practices for all wiring methods as described in NEC® Article 300.
426.2	**RECALL** properties and NEC® requirements for various cables, raceways, and other wiring methods.
426.3	**REVIEW** calculations for sizing raceways and wireways.
426.4	**REVIEW** calculations for sizing outlet device and junction boxes.
426.5	**REVIEW** calculations for sizing pull boxes containing 4 AWG or larger.
Lesson 427 - First Semester 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	**MASTER** general requirements for switches as per NEC® 404.
428.2	**RECOGNIZE** characteristics of switchboards and panelboard as per NEC® 408.
Lesson 429 - Equipment for General Use, NEC® 400, 406, 410, and 422	
429.1	**REVIEW** the rating, installation, and overcurrent protection requirements for flexible cords.
429.2	**REVIEW** the type, grounding, and installation requirements for receptacles, cord connectors, and attachment plugs.
429.3	**REVIEW** the location, support, grounding, and installation requirements for luminaires.
429.4	**REVIEW** 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	**REVIEW** motors, motor circuits, and motor controllers.
430.2	**REVIEW** air conditioning and refrigeration equipment.
430.3	**REVIEW** generators.
430.4	**REVIEW** fire pump requirements.
Lesson 431 - Transformers: NEC® 450	
431.1	**RECALL** various types of transformers and their construction.
431.2	**IDENTIFY** NEC® and manufacturer's transformer installation requirements.
431.3	**IDENTIFY** NEC® requirements for transformer vaults.
431.4	**MASTER** the NEC® requirements for the protection of transformers and primary conductors against overcurrent.
431.5	**MASTER** 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	**IDENTIFY** NEC® requirements for hazardous locations and their classifications.
432.2	**IDENTIFY** NEC® requirements for commercial garages and motor fuel dispensing facilities.
432.3	**IDENTIFY** NEC® requirements for health care facilities.
432.4	**IDENTIFY** 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 knowlege 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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