

# Course Outline

Energy, Environment, and Utilities

REVISED: August/2017

**Job Title**  
Electrician

**72-75-65**

**Career Pathway:**  
Energy and Power Technology

**Electrician/4: Industrial**

**Industry Sector:**  
Energy, Environment, and  
Utilities

**Credits:** 30

**Hours:** 360

**O\*NET-SOC CODE:**  
47-2111.00

**Course Description:**

This competency-based course is the fourth in a sequence of five designed for electrical technician and electrician trainees. It provides students with technical instruction and practical experience in workplace safety, code-approved wiring techniques, AC theory, and resource management. It focuses on AC and DC motors and generators, single-phase motors, three-phase power systems and machines, testing procedures on live circuits, motor control, troubleshooting and maintenance techniques. The competencies in this course are aligned with the California High School Academic Content Standards and the California Career Technical Education Model Curriculum Standards.

**CBEDS Title:**  
Introduction to Electrical Power  
Systems

**Prerequisites:**

Enrollment requires completion of the Electrician/3: Wiring Techniques (72-75-60) course.

**CBEDS No.:**  
5583

**NOTE:** For Perkins purposes this course has been designated as a **capstone** course.

This course cannot be repeated once a student receives a Certificate of Completion.



## **COURSE OUTLINE COMPETENCY-BASED COMPONENTS**

A course outline reflects the essential intent and content of the course described. Acceptable course outlines have six components. (Education Code Section 52506). Course outlines for all apportionment classes, including those in jails, state hospitals, and convalescent hospitals, contain the six required elements:

(EC 52504; 5CCR 10508 [b]; Adult Education Handbook for California [1977], Section 100)

### **COURSE OUTLINE COMPONENTS**

### **LOCATION**

#### **GOALS AND PURPOSES**

Cover

The educational goals or purposes of every course are clearly stated and the class periods are devoted to instruction. The course should be broad enough in scope and should have sufficient educational worth to justify the expenditure of public funds.

The goals and purpose of a course are stated in the COURSE DESCRIPTION. Course descriptions state the major emphasis and content of a course, and are written to be understandable by a prospective student.

#### **PERFORMANCE OBJECTIVES OR COMPETENCIES**

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Objectives should be delineated and described in terms of measurable results for the student and include the possible ways in which the objectives contribute to the student's acquisition of skills and competencies.

Performance Objectives are sequentially listed in the COMPETENCY-BASED COMPONENTS section of the course outline. Competency Areas are units of instruction based on related competencies. Competency Statements are competency area goals that together define the framework and purpose of a course. Competencies fall on a continuum between goals and performance objectives and denote the outcome of instruction.

Competency-based instruction tells a student before instruction what skills or knowledge they will demonstrate after instruction. Competency-based education provides instruction which enables each student to attain individual goals as measured against pre-stated standards.

Competency-based instruction provides immediate and continual repetition and In competency-based education the curriculum, instruction, and assessment share common characteristics based on clearly stated competencies. Curriculum, instruction and assessment in competency-based education are: explicit, known, agreed upon, integrated, performance oriented, and adaptive.

**COURSE OUTLINE COMPETENCY-BASED COMPONENTS**  
**(continued)**

**COURSE OUTLINE COMPONENTS**

**LOCATION**

**INSTRUCTIONAL STRATEGIES**

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Instructional techniques or methods could include laboratory techniques, lecture method, small-group discussion, grouping plans, and other strategies used in the classroom.

Instructional strategies for this course are listed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructional strategies and activities for a course should be selected so that the overall teaching approach takes into account the instructional standards of a particular program, i.e., English as a Second Language, Programs for Adults with Disabilities.

**UNITS OF STUDY, WITH APPROXIMATE HOURS ALLOTTED FOR EACH UNIT**

Cover

The approximate time devoted to each instructional unit within the course, as well as the total hours for the course, is indicated. The time in class is consistent with the needs of the student, and the length of the class should be that it ensures the student will learn at an optimum level.

pp. 7-13

Units of study, with approximate hours allotted for each unit are listed in the COMPETENCY AREA STATEMENT(S) of the course outline. The total hours of the course, including work-based learning hours (community classroom and cooperative vocational education) is listed on the cover of every CBE course outline. Each Competency Area listed within a CBE outline is assigned hours of instruction per unit.

**EVALUATION PROCEDURES**

p. 15

The evaluation describes measurable evaluation criteria clearly within the reach of the student. The evaluation indicates anticipated improvement in performances as well as anticipated skills and competencies to be achieved.

Evaluation procedures are detailed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructors monitor students' progress on a continuing basis, assessing students on attainment of objectives identified in the course outline through a variety of formal and informal tests (applied performance procedures, observations, and simulations), paper and pencil exams, and standardized tests.

**REPETITION POLICY THAT PREVENTS PERPETUATION OF STUDENT ENROLLMENT**

Cover

After a student has completed all the objectives of the course, he or she should not be allowed to reenroll in the course. There is, therefore, a need for a statement about the conditions for possible repetition of a course to prevent perpetuation of students in a particular program for an indefinite period of time.

## **ACKNOWLEDGMENTS**

Thanks to PAUL PIDOUX and MARCELA BAKER for developing and editing this curriculum. Acknowledgment is also given to ERICA ROSARIO for designing the original artwork for the course covers.

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# **CALIFORNIA CAREER TECHNICAL EDUCATION MODEL CURRICULUM STANDARDS**

## ***Energy, Environment and Utilities Industry Sector***

### ***Knowledge and Performance Anchor Standards***

#### **1.0 Academics**

Analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment. Refer to the Energy, Environment, and Utilities academic alignment matrix for identification of standards.

#### **2.0 Communications**

Acquire, and accurately use Energy, Environment, and Utilities sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats.

#### **3.0 Career Planning and Management**

Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.

#### **4.0 Technology**

Use existing and emerging technology to investigate, research, and produce products and services, including new information, as required in the Energy, Environment, and Utilities sector workplace environment.

#### **5.0 Problem Solving and Critical Thinking**

Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the Energy, Environment, and Utilities sector using critical and creative thinking; logical reasoning, analysis, inquiry, and problem-solving techniques.

#### **6.0 Health and Safety**

Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Energy, Environment, and Utilities sector workplace environment.

#### **7.0 Responsibility and Flexibility**

Initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the Energy, Environment, and Utilities sector workplace environment and community settings.

#### **8.0 Ethics and Legal Responsibilities**

Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms.

#### **9.0 Leadership and Teamwork**

Work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution as practiced in the SkillsUSA career technical student organization.

#### **10.0 Technical Knowledge and Skills**

Apply essential technical knowledge and skills common to all pathways in the Energy, Environment, and Utilities sector.

#### **11.0 Demonstration and Application**

Demonstrate and apply the knowledge and skills contained in the Energy, Environment, and Utilities anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and through the SkillsUSA career technical student organization.

## ***Energy, Environment, and Utilities Sector Pathway Standards***

### **B. Energy and Power Technology Pathway**

The Energy and Power Technology pathway provides learning opportunities for students interested in preparing for careers in the energy and power industries.

Sample occupations associated with this pathway:

- ◆ Energy Efficiency Evaluation Specialist
- ◆ Energy Engineer
- ◆ Energy Generation/Power Distribution, Maintenance, Inspection, and Repair Technicians
- ◆ Energy/Building Retrofit Specialist
- ◆ Plant/Field Weatherization Installer

- B1.0 Explore the basic conventional and emerging principles and concepts of the energy industry, including energy production, energy transmission, and alternative energy technologies.
- B2.0 Identify various conventional electric power generation fuel sources and the cost and efficiency issues associated with each.
- B3.0 Investigate emerging and alternative electric power generation technologies and fuel sources.
- B4.0 Understand nonnuclear power generation plant operations (coal, oil, natural gas, solar, wind, geothermal power, hydroelectric, or biofuel).
- B5.0 Understand and apply basic knowledge and skills necessary for nuclear power generation and nuclear power plant personnel.
- B6.0 Research methods of energy procurement, transmission, distribution, and storage.
- B7.0 Understand the interrelationships among components of systems.

**CBE**  
**Competency-Based Education**

**COMPETENCY-BASED COMPONENTS**  
**for the Electrician/4: Industrial Course**

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>A. WORKPLACE SAFETY REVIEW</p> <p>Review, apply, and evaluate the safety practices and approved materials for the industry.</p> <p>(2 hours)</p>	<ol style="list-style-type: none"> <li>1. Review at least five workplace safety procedures.</li> <li>2. Review first aid practices that apply to industrial electricians.</li> <li>3. Demonstrate Cardio-Pulmonary Resuscitation (CPR).</li> <li>4. Pass written safety exam with 100% accuracy.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 6</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3 Health and Safety: 6.1, 6.4, 6.5, 6.8, 6.11</p> <p><b>CTE Pathway:</b> B1.7</p>
<p>B. WIRING TECHNIQUES</p> <p>Understand, apply, and evaluate code-approved wiring techniques.</p>	<ol style="list-style-type: none"> <li>1. Review the construction of wire.</li> <li>2. Review sizing capacities.</li> <li>3. Review the features and functions of the following components:               <ol style="list-style-type: none"> <li>a. automotive /boat wiring</li> <li>b. marine wiring</li> <li>c. commercial /industrial wiring</li> </ol> </li> <li>4. Review and demonstrate the wire selection process according to planned use.</li> <li>5. Review and demonstrate splices.</li> <li>6. Review and demonstrate connections.</li> <li>7. Review and demonstrate solderless connections.</li> <li>8. Review and demonstrate the installation techniques for basic electrical boxes.</li> <li>9. Review and demonstrate the installation techniques for conduits.</li> <li>10. Review and demonstrate the wiring techniques for basic commercial-type circuits.</li> <li>11. Describe and demonstrate the techniques for working on energized circuits.</li> <li>12. Describe and demonstrate good housekeeping practices.</li> <li>13. Describe the function and features of various lighting systems.</li> <li>14. Describe the operation of various lighting systems.</li> <li>15. Describe the features and functions of the following:               <ol style="list-style-type: none"> <li>a. overcurrent protective devices</li> <li>b. ground fault circuit interrupters</li> <li>c. surge protectors</li> </ol> </li> <li>16. Describe the operations of the following:</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 3, 5, 6</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health and Safety: 6.1, 6.2, 6.4, 6.5, 6.6, 6.8, 6.9, 6.11, 6.12, 6.14, 6.15, 6.16 Ethics and Legal Responsibilities: 8.2 Technical Knowledge and Skills: 10.1, 10.2, 10.3</p> <p><b>CTE Pathway:</b> B1.4, B1.7, B7.3, B7.6</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
	<ul style="list-style-type: none"> <li>a. overcurrent protective devices</li> <li>b. ground fault circuit interrupters</li> <li>c. surge protectors</li> </ul> <p>17. Describe the reasons for grounding.</p> <p>18. Describe the following in relation to grounding systems:</p> <ul style="list-style-type: none"> <li>a. characteristics</li> <li>b. function</li> <li>c. operation</li> </ul> <p>19. Identify the general types of faults.</p> <p>20. Describe the different types of grounding electrode systems.</p> <p>21. Describe and demonstrate the following regarding grounding systems:</p> <ul style="list-style-type: none"> <li>a. sizing</li> <li>b. layout</li> <li>c. installation</li> </ul> <p>22. Describe the NEC requirements and interpretations.</p> <p>23. Identify the different sizes of conductors and electrodes.</p> <p>24. Describe and demonstrate the installation of the following:</p> <ul style="list-style-type: none"> <li>a. electrodes</li> <li>b. conductors</li> <li>c. connection</li> </ul> <p>25. Describe the impact of soil conditions on earth grounding systems and equipment.</p> <p>26. Describe and demonstrate the procedures for earth resistance testing.</p> <p>27. Describe and demonstrate the procedures for ground fault protection as required by code.</p> <p>28. Describe the differences between the following:</p> <ul style="list-style-type: none"> <li>a. insulation</li> <li>b. isolation</li> <li>c. elevation</li> </ul> <p>29. Describe the differences between:</p> <ul style="list-style-type: none"> <li>a. grounding</li> <li>b. grounded</li> <li>c. bonding</li> </ul> <p>30. Describe the following special circumstances:</p> <ul style="list-style-type: none"> <li>a. systems over 1000 volts</li> <li>b. separately derived systems</li> <li>c. buildings sharing service</li> </ul> <p>31. Review the differences between:</p> <ul style="list-style-type: none"> <li>a. wiring diagrams</li> <li>b. line diagrams</li> <li>c. schematics</li> <li>d. ladder diagrams</li> </ul> <p>32. Make complete diagrams based on given schematics.</p> <p>33. Create drawings showing conduits and conductors using appropriate scale based on given panels and equipment layouts.</p> <p>34. Describe the conditions that require specialty systems.</p> <p>35. Describe the features and functions of various types of fire alarm systems and components.</p>	



COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(100 hours)	<p>36. Describe the operations of various types of fire alarm systems and components.</p> <p>37. Describe the code requirements regarding fire alarm systems and components.</p> <p>38. Answer specific questions about fire alarm systems and components using the NEC.</p> <p>39. Describe and demonstrate the installation of various fire alarms.</p> <p>40. Describe the following regarding alarm initiating and indicating devices:</p> <ul style="list-style-type: none"> <li>a. features</li> <li>b. functions</li> <li>c. operations</li> </ul> <p>41. Demonstrate multiplexing of fire alarm system components.</p> <p>42. Describe various types of areas and the methods used to protect them.</p> <p>43. Demonstrate the appropriate wiring devices and methods.</p> <p>44. Utilize manuals to start-up and check out the system.</p> <p>45. Utilize proper manuals and techniques for system maintenance and troubleshooting.</p> <p>46. Describe the following regarding various security systems and components:</p> <ul style="list-style-type: none"> <li>a. features</li> <li>b. functions</li> <li>c. operations</li> </ul> <p>47. Describe NEC requirements for security systems and components.</p> <p>48. Answer specific questions about security systems and components using the NEC.</p> <p>49. Demonstrate multiplexing of security system components.</p> <p>50. Describe various types of areas and the methods used to protect them.</p> <p>51. Demonstrate appropriate wiring devices and methods for security systems.</p> <p>52. Utilize manuals to start-up and check out the system.</p> <p>53. Utilize proper manuals and techniques for system maintenance and troubleshooting.</p> <p>54. Describe the features, functions, and operations of the following:</p> <ul style="list-style-type: none"> <li>a. various types of voice systems</li> <li>b. various types of data systems</li> <li>c. various types of TV systems</li> <li>d. various types of signaling systems</li> </ul> <p>55. Describe the proper cabling systems required for various systems.</p> <p>56. Describe and demonstrate the installation and connection techniques for cables and devices.</p> <p>57. Explain how cable defects and installation errors can degrade the system.</p> <p>58. Utilize proper manuals and techniques for system maintenance and troubleshooting.</p> <p>59. Describe lightning protection systems.</p> <p>60. Describe fiber optic systems.</p> <p>61. Describe controls for heating, air conditioning, and refrigeration (HVAC) systems.</p>	

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>C. ALTERNATING CURRENT (AC) REVIEW</p> <p>Review and apply the fundamentals of AC theory.</p> <p>(6 hours)</p>	<ol style="list-style-type: none"> <li>1. List proper color coding for single-phase circuits.</li> <li>2. List proper color coding for single-phase coding.</li> <li>3. Identify the conductor for ground on 120 and 277 volt circuits.</li> <li>4. Identify the conductor for neutral on 120 and 277 volt circuits.</li> <li>5. List standard practice of identifying various switch legs.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 3</p> <p><b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> B7.5</p>
<p>D. AC/DC MOTORS AND GENERATORS</p> <p>Understand, apply, and evaluate the fundamentals of AC/DC motors and generators.</p>	<ol style="list-style-type: none"> <li>1. Describe AC motors.</li> <li>2. Describe DC motors.</li> <li>3. Differentiate between AC and DC motors.</li> <li>4. Describe methods to identify windings in DC motors.</li> <li>5. Describe methods for providing: <ol style="list-style-type: none"> <li>a. field failure</li> <li>b. current limit</li> <li>c. voltage control</li> <li>d. speed control</li> </ol> </li> <li>6. Create block diagrams to demonstrate: <ol style="list-style-type: none"> <li>a. power supplies</li> <li>b. armatures</li> <li>c. field and control features</li> </ol> </li> <li>7. Describe starting and operating characteristics for various motors.</li> <li>8. Define the following: <ol style="list-style-type: none"> <li>a. torque</li> <li>b. locked rotor current</li> <li>c. no-load speed</li> <li>d. slip</li> </ol> </li> <li>9. Explain Silicon-Controlled Rectifier (SCR) controls for DC motors.</li> <li>10. Describe AC generators (alternators).</li> <li>11. Describe DC generators.</li> <li>12. Differentiate between AC and DC generators.</li> <li>13. List the characteristics of single-phase motors.</li> <li>14. List the types of single-phase motors.</li> <li>15. List the characteristics of poly-phase motors.</li> <li>16. List the types of poly-phase motors.</li> <li>17. Describe the cause of motor losses.</li> <li>18. Differentiate between single- and poly-phase motors.</li> <li>19. Describe physical construction of various motors.</li> <li>20. Describe how to utilize the following to gain information about motors: <ol style="list-style-type: none"> <li>a. information sheets</li> <li>b. plans</li> <li>c. schematics</li> <li>d. motor nameplates</li> </ol> </li> <li>21. Describe "power factor."</li> </ol>	<p><b>Career Ready Practice:</b> 1, 3, 5</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health and Safety: 6.1, 6.2, 6.4, 6.6, 6.11 Ethics and Legal Responsibilities: 8.2 Technical Knowledge and Skills: 10.1, 10.2</p> <p><b>CTE Pathway:</b> B1.4, B1.7, B6.3, B7.3, B7.5, B7.6</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(50 hours)	22. Demonstrate proper techniques for motor installation. 23. Demonstrate code calculations. 24. Demonstrate installation of proper wire type and size for various motors. 25. Demonstrate connecting multispeed and reversible motors.	
E. SINGLE-PHASE MOTORS  Understand, apply, and evaluate the different types, features, and operations of single-phase motors.	1. List the parts of a split-phase motor. 2. Explain the action of the two windings. 3. Explain the action of the capacitor in the motor. 4. Distinguish between split-phase and capacitor-start motors. 5. Describe the use of the starter capacitor and the centrifugal switch. 6. Describe the method of checking the running or starting capacitor. 7. Describe maintenance areas particular to single-phase motors. 8. Differentiate between series motors and split-phase motors. 9. Describe areas of greater maintenance in series motors.	<b>Career Ready Practice:</b> 1, 3, 4, 5  <b>CTE Anchor:</b> Communications: 2.1, 2.2 Ethics and Legal Responsibility: 8.2 Technical Knowledge and Skills: 10.1, 10.2  <b>CTE Pathway:</b> B4.2, B5.2
F. THREE-PHASE MOTORS  Understand, apply, and evaluate the three-phase power systems and machines.	1. Identify parts of an alternator. 2. Describe the function of various parts of an alternator. 3. Relate electrical power out to mechanical power required. 4. Compare the alternator to the synchronous motor. 5. List possible maintenance trouble points in motors. 6. List operating cautions for motors. 7. List major measurements to be made for troubleshooting. 8. Describe a simple preventative maintenance program. 9. Describe the delta power distribution system. 10. Describe the wye power distribution system. 11. Identify phase relationships in three-phase systems. 12. Calculate current and power in wye systems. 13. List cautions to be observed in wye systems. 14. List the main parts of a three-phase induction motor. 15. Draw a typical rotor, identifying parts. 16. Draw a typical stator, identifying parts. 17. Describe a rotating magnetic field and its effect on a rotor. 18. Analyze starting and running current. 19. Describe "single-phasing". 20. Describe the nameplate information on motors. 21. Connect motors for high and low voltages. 22. Describe the rule for reversing three-phase motors.	<b>Career Ready Practice:</b> 1, 3, 4, 5  <b>CTE Anchor:</b> Communications: 2.1, 2.2 Problem Solving and Critical Thinking: 5.1, 5.2 Health and Safety: 6.1, 6.6, 6.8, 6.9, 6.11, 6.15, 6.16 Technical Knowledge and Skills: 10.1, 10.2  <b>CTE Pathway:</b> B4.2, B5.2

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>G. TESTING PROCEDURES ON LIVE CIRCUITS</p> <p>Understand, apply, and evaluate the proper procedures for testing live circuits.</p> <p>(10 hours)</p>	<ol style="list-style-type: none"> <li>1. Describe and demonstrate the proper checking procedures for motor control circuits.</li> <li>2. Describe and demonstrate the proper testing procedures on time clocks.</li> <li>3. Describe and demonstrate the proper connecting procedures for switching and lighting controls.</li> <li>4. Describe and demonstrate the proper procedures for testing motor starters.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 3</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2 Problem Solving and Critical Thinking: 5.1 Health and Safety: 6.6, 6.15 Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> B7.4</p>
<p>H. MOTOR CONTROL</p> <p>Understand, apply, and evaluate the interpretation, wiring, and troubleshooting techniques for specific motor control problems in the lab and practical situations.</p> <p>(50 hours)</p>	<ol style="list-style-type: none"> <li>1. List various types of starters.</li> <li>2. Describe manual starters.</li> <li>3. Describe magnetic starters.</li> <li>4. Describe pilot devices.</li> <li>5. Describe the use of the following pilot devices: <ol style="list-style-type: none"> <li>a. thermostats</li> <li>b. float switches</li> <li>c. light switches</li> </ol> </li> <li>6. Demonstrate basic control circuits.</li> <li>7. Describe three-phase controls.</li> <li>8. Describe DC controllers.</li> <li>9. Describe deceleration as it applies to motors.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 3, 4, 5</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2 Ethics and Legal Responsibilities: 8.2 Technical Knowledge and Skills: 10.1, 10.2</p> <p><b>CTE Pathway:</b> B5.2</p>
<p>I. TROUBLESHOOTING AND MAINTENANCE</p> <p>Understand, apply, and evaluate the interpretation, wiring, and troubleshooting techniques for specific motor control problems in the lab and practical situations.</p>	<ol style="list-style-type: none"> <li>1. List at least three principles of maintenance.</li> <li>2. List at least three ways of correcting existing problems.</li> <li>3. Describe various ways of preventing the recurrence of a problem.</li> <li>4. Identify the principles of troubleshooting.</li> <li>5. Demonstrate logical thought when troubleshooting class project problems.</li> <li>6. Participate in a class project involving troubleshooting.</li> <li>7. Demonstrate good recordkeeping when troubleshooting a problem.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 3, 4, 5</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2 Problem Solving and Critical Thinking: 5.1, 5.4</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(40 hours)		Health and Safety: 6.6, 6.15 Technical Knowledge and Skills: 10.1, 10.5  <b>CTE Pathway:</b> B7.4
J. RESOURCE MANAGEMENT REVIEW  Review, apply, and evaluate resource management in the electrical industry.  (2 hours)	<ol style="list-style-type: none"> <li>1. Review the following:               <ol style="list-style-type: none"> <li>a. resources</li> <li>b. management</li> <li>c. sustainability</li> </ol> </li> <li>2. Review the management of the following resources:               <ol style="list-style-type: none"> <li>a. time</li> <li>b. materials</li> <li>c. personnel</li> </ol> </li> <li>3. List specific examples of effective management of the following in the electrical industry:               <ol style="list-style-type: none"> <li>a. time</li> <li>b. materials</li> <li>c. personnel</li> </ol> </li> <li>4. Review the following benefits of effective resource management in the electrical industry:               <ol style="list-style-type: none"> <li>a. profitability</li> <li>b. company growth</li> <li>c. stability</li> </ol> </li> </ol>	<b>Career Ready Practice:</b> 1, 2, 3, 8, 11  <b>CTE Anchor:</b> Communications: 2.1 Problem Solving and Critical Thinking: 5.1, 5.4 Responsibility & Flexibility: 7.1, 7.2, 7.3, 7.4, 7.6 Ethics and Legal Responsibilities: 8.3, 8.4, 8.5  <b>CTE Pathway:</b> B1.6

## ***SUGGESTED INSTRUCTIONAL MATERIALS and OTHER RESOURCES***

### **TEXTS AND SUPPLEMENTAL BOOKS**

Miller, Charles R. NFPA's Pocket Electrical References. Jones and Bartlett Publishers, 2006.

National Fire Protection Association. User's Guide to the National Electrical Code, 2008 Edition. Jones and Bartlett Publishers, 2009

Stallcup, James G. Stallcup's Electrical Grounding and Bonding Simplified, 2008 Edition. Jones and Bartlett Publishers, 2010

Stauffer, H. Brooke. NFPA's Residential Wiring, 3<sup>rd</sup> Edition. Jones and Bartlett Publishers, 2009.

Trout, Charles M. Essentials of Electric Motors and Controls. Jones and Bartlett Publishers, 2010.

Williams, Noel. NEC Q&A: Questions and Answers on the National Electrical Code. Jones and Bartlett Publishers, 2007.

### **RESOURCES**

Employer Advisory Board members

CTE Model Curriculum Standards

<http://www.cde.ca.gov/ci/ct/sf/documents/energyutilities.pdf>

Local representatives of the IBEW

Representatives/members of the International Association of Electrical Inspectors

[www.americangreenjobs.net](http://www.americangreenjobs.net)

### **COMPETENCY CHECKLIST**

## ***TEACHING STRATEGIES and EVALUATION***

### **METHODS AND PROCEDURES**

- A. Lecture and discussion
- B. Multi-media presentations
- C. Visual aids
- D. Reference reading and study
- E. Individualized instruction

### **EVALUATION**

SECTION A – Workplace Safety Review – Pass the safety test with 100% accuracy.

SECTION B – Wiring Techniques – Pass all assignments and exams on wiring techniques with a minimum score of 80% or higher.

SECTION C – Alternating Current (AC) Theory Review – Pass all assignments and exams on alternating current (AC) theory review with a minimum score of 80% or higher.

SECTION D – AC/DC Motors and Generators – Pass all assignments and exams on AC/DC motors and generators with a minimum score of 80% or higher.

SECTION E – Single-Phase Motors – Pass all assignments and exams on single-phase motors with a minimum score of 80% or higher.

SECTION F – Three-Phase Power Systems and Machines – Pass all assignments and exams on three-phase power systems and machines with a minimum score of 80% or higher.

SECTION G – Testing Procedures on Live Circuits – Pass all assignments and exams on testing procedures on live circuits with a minimum score of 80% or higher.

SECTION H – Motor Control – Pass all assignments and exams on motor control with a minimum score of 80% or higher.

SECTION I – Troubleshooting and Maintenance – Pass all assignments and exams on troubleshooting and maintenance with a minimum score of 80% or higher.

SECTION J – Resource Management Review – Pass all assignments and exams on resource management review with a minimum score of 80% or higher.

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### Statement for Civil Rights

All educational and vocational opportunities are offered without regard to race, color, national origin, gender, or physical disability.

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