Job Title
Electrician

Career Pathway:
Energy and Power Technology

Industry Sector:
Energy, Environment, and Utilities

O*NET-SOC CODE:
47-2111.00

CBEDS Title:
Introduction to Electrical Power Systems

CBEDS No.:
5583

72-75-60

Electrician/3: Wiring Techniques

Credits: 20
Hours: 240

Course Description:
This competency-based course is the third in a sequence of five designed for electrical technician and electrician trainees. It provides students with technical instruction and practical experience in wiring. It focuses on the selection and utilization of electrical instrumentation, proper interpretation of wire color connections, proper wiring techniques, and the types, features, and functions of blueprint drawings and prints. It also includes workplace safety. The competencies in this course are aligned with the California High School Academic Content Standards and the California Career Technical Education Model Curriculum Standards.

Prerequisites:
Enrollment requires completion of the Electrician/2: Wiring and Codes (72-75-55) course.

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.
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; SCCR 10508 [b]; Adult Education Handbook for California [1977], Section 100)

### COURSE OUTLINE COMPONENTS

#### GOALS AND PURPOSES

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

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

INSTRUCTIONAL STRATEGIES

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

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.

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

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

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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Career Technical Education

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Division of Adult and Career Education

APPROVED:

JOE STARK
Executive Director
Division of Adult and Career Education
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.
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/3: Wiring Techniques Course

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<thead>
<tr>
<th>COMPETENCY AREAS AND STATEMENTS</th>
<th>MINIMAL COMPETENCIES</th>
<th>STANDARDS</th>
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<tbody>
<tr>
<td><strong>A. WORKPLACE SAFETY</strong></td>
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</table>
| Understand, apply, and evaluate the safety practices and approved materials for the industry. | 1. Describe the California Occupational Safety and Health Administration (Cal/OSHA) safety standards for electricians.  
2. Identify locations of all emergency “stop” switches.  
3. Know the escape route in the event of an earthquake.  
4. Describe first aid practices that apply to the different types of electricians.  
5. Pass the written safety test with 100% accuracy. | Career Ready Practice:  
1, 6  
CTE Anchor:  
Communications: 2.1, 2.2  
Health and Safety: 6.1, 6.2, 6.5, 6.6, 6.7, 6.8, 6.9, 6.11  
CTE Pathway: B4.1 |
| (10 hours)                       |                      |           |
| **B. BASIC ELECTRICAL TEST EQUIPMENT** |                      |           |
| Understand, apply, and evaluate the techniques for the selection and utilization of electrical instrumentation. | 1. Describe the basic meter theory.  
2. Identify the following:  
   a. multimeters  
   b. meggers  
   c. clamp-on meters  
   d. analog meters  
   e. digital meters  
3. Describe the features and functions of the following:  
   a. multimeters  
   b. meggers  
   c. clamp-on meters  
4. Describe the proper use of the following:  
   a. multimeters  
   b. meggers  
   c. clamp-on meters  
5. Demonstrate the proper procedures for storing and maintaining the following:  
   a. multimeters  
   b. meggers  
   c. clamp-on meters  
6. Differentiate between wheatstone bridges and meggers.  
7. Define frequency as it applies to alternating current (AC).  
8. Differentiate between power meters and power factor meters.  
9. Describe the principle of analog meter movements. | Career Ready Practice:  
1, 3, 4, 5, 11  
CTE Anchor:  
Communications: 2.1, 2.2, 2.3  
Health and Safety: 6.3, 6.6, 6.9, 6.11, 6.12, 6.15, 6.16  
Technical Knowledge and Skills: 10.5  
CTE Pathway: B7.3, B7.4 |
<table>
<thead>
<tr>
<th>COMPETENCY AREAS AND STATEMENTS</th>
<th>MINIMAL COMPETENCIES</th>
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<tbody>
<tr>
<td>10. Demonstrate the accurate interpolation of readings on the analog meter.</td>
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<tr>
<td>11. Describe the features and functions of the following:</td>
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<tr>
<td>a. digital instruments</td>
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<td>b. analog instruments</td>
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<tr>
<td>12. Demonstrate the proper selection procedures for a required meter and range for a given problem.</td>
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<td>13. Describe the features and functions of the following specialty instruments:</td>
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<tr>
<td>a. the Wiggy</td>
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<td>b. clamp-on ammeter</td>
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<td>c. Tic-tracer</td>
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<td>d. watt-meter</td>
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<tr>
<td>e. frequency meter</td>
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<td>14. Describe the features and functions of the following:</td>
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<tr>
<td>a. voltmeter/ammeter</td>
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<td>b. ohmmeter</td>
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<tr>
<td>15. Demonstrate the proper testing procedures using the following:</td>
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<tr>
<td>a. voltmeter/ammeter</td>
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<td></td>
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<td>b. ohmmeter</td>
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<tr>
<td>16. Demonstrate the proper acceptance testing procedures for cables.</td>
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<td>17. Demonstrate the proper maintenance testing procedures for generators.</td>
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<td>18. Demonstrate the proper insulation test procedures for a megohmeter.</td>
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<tr>
<td>19. Describe the features and functions of high voltage cable and insulators.</td>
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<td>20. Demonstrate the proper method when checking the integrity of insulation.</td>
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<td>21. Describe the special requirements for high voltage testing.</td>
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<td>22. Demonstrate the use of ‘no contact’ voltage indicators.</td>
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<td>23. Demonstrate the appropriate tests used for instrumentation.</td>
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<td>24. Demonstrate the appropriate methods used for instrumentation.</td>
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<td>25. Demonstrate the appropriate voltages used for instrumentation.</td>
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<tr>
<td>26. Demonstrate the appropriate equipment used for instrumentation.</td>
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(40 hours)

C. WIRE COLOR CONNECTIONS

Understand, apply, and evaluate the techniques for proper interpretation of wire color connections.

1. List proper color coding for single-phase circuits.
2. List proper color coding for single-phase coding.
3. Identify the conductor for ground on 120 and 277 volt circuits.
4. Identify the conductor for neutral on 120 and 277 volt circuits.
5. List standard practice of identifying various switch legs.

Career Ready Practice:
1, 3

CTE Anchor:
Communications: 2.1, 2.2, 2.3
Health and Safety: 6.1, 6.11, 6.16
Ethics and Legal Responsibilities: 8.2
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>D. WIRING TECHNIQUES</strong></td>
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</table>
| Understand, apply, and evaluate the proper wiring techniques | 1. Describe the use of cords.  
2. Describe the use of non-metallic sheathed cable.  
3. Demonstrate the proper use of building wire.  
4. Describe proper fill of conduit.  
5. Describe proper number of wires in a circuit.  
6. Demonstrate the proper procedure for calculating the following:  
   a. line loss/voltage drop  
   b. branch circuits  
   c. feeder wire requirements  
   d. motor feeder requirements of wire and raceway  
7. Describe the one-line diagram distribution systems on the following:  
   a. residential  
   b. commercial  
   c. industrial projects  
8. Demonstrate the proper use of schematics to describe nominal voltages.  
9. Describe the features and functions of the following:  
   a. transformers  
   b. motor starters  
   c. control circuits  
   d. conductors  
10. Describe the construction of wire.  
11. Explain what is meant by sizing capacities.  
12. List the components of the following  
   a. marine wiring  
   b. automotive/boat wiring  
   c. commercial industrial wiring  
13. Describe and demonstrate the proper selection procedures for wires according to planned use.  
14. Describe and demonstrate the following:  
   a. splices  
   b. connections  
   c. solder-less connections  
15. Describe and demonstrate the ability to install the following:  
   a. basic electrical boxes  
   b. conduits  
16. Describe and demonstrate the ability to wire basic commercial type circuits. | Technical Knowledge and Skills:  
10.1, 10.2  
CTE Pathway:  
B4.1  
Career Ready Practice:  
1, 2, 3, 4, 5  
CTE Anchor:  
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  
CTE Pathway:  
B5.2, B7.4, B7.5 |
### COMPETENCY AREAS AND STATEMENTS

<table>
<thead>
<tr>
<th>MINIMAL COMPETENCIES</th>
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<tbody>
<tr>
<td><strong>E. BLUEPRINT READING</strong></td>
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<tr>
<td>Understand, apply, and evaluate the types, features, and functions of blueprint drawings and prints.</td>
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<tr>
<td>1. Identify the use of the following information blocks:</td>
<td>Career Ready Practice:</td>
</tr>
<tr>
<td>a. title block</td>
<td>1, 2, 3, 5, 11</td>
</tr>
<tr>
<td>b. change block</td>
<td>CTE Anchor:</td>
</tr>
<tr>
<td>c. gear and spline data</td>
<td>Communications:</td>
</tr>
<tr>
<td>d. notes</td>
<td>2.1, 2.2, 2.3, 2.4, 2.5</td>
</tr>
<tr>
<td>1. Explain what is meant by views or projections.</td>
<td>Problem Solving and Critical Thinking:</td>
</tr>
<tr>
<td>2. Identify the following types of lines:</td>
<td>5.1, 5.2, 5.3, 5.4</td>
</tr>
<tr>
<td>a. outline or visible</td>
<td>Ethics and Legal Responsibility:</td>
</tr>
<tr>
<td>b. section</td>
<td>8.2</td>
</tr>
<tr>
<td>c. hidden</td>
<td>Technical Knowledge and Skills:</td>
</tr>
<tr>
<td>d. center</td>
<td>10.1, 10.2</td>
</tr>
<tr>
<td>e. dimension</td>
<td>CTE Pathway:</td>
</tr>
<tr>
<td>f. cutting plane</td>
<td>B7.6</td>
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<tr>
<td>g. break lines</td>
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<td>3. Explain how the following terms apply to dimension:</td>
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<td>a. fractional</td>
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<td>b. decimal</td>
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<td>c. angular</td>
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<td>4. Explain how the following terms apply to tolerance:</td>
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<tr>
<td>a. fractional</td>
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<tr>
<td>b. decimal</td>
<td></td>
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<tr>
<td>c. angular</td>
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<tr>
<td>5. Identify the symbols and abbreviations used in blueprint reading.</td>
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<td>6. Demonstrate the accurate use of architectural prints.</td>
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<td>7. Describe the creation of the following:</td>
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<td>a. blueprints</td>
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<td>b. plans</td>
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<td>c. specifications</td>
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<td>8. Identify the different types of symbols used in electrical and related trades.</td>
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<td>9. Describe the functions of basic line types.</td>
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<td>10. Identify drawing tools and techniques.</td>
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<td>11. Recognize and apply dimensions to the drawings.</td>
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<td>12. Prepare ‘as built’ drawings.</td>
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<tr>
<td>13. Describe the features and functions of the following:</td>
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<tr>
<td>a. wiring diagrams</td>
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<td>b. line diagrams</td>
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<td>c. schematics</td>
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<tr>
<td>d. ladder diagrams</td>
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<tr>
<td>14. Describe the use of blueprint specifications.</td>
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<tr>
<td>15. Describe the functions of the various types of:</td>
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<tr>
<td>a. plots</td>
<td></td>
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<td>b. sections</td>
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<td>c. details</td>
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<td>d. schedules</td>
<td></td>
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<tr>
<td>e. specification sheets</td>
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<tr>
<td>f. addendums and revisions</td>
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*(30 hours)*

(72-75-60) WeAreDACE.Org
SUGGESTED INSTRUCTIONAL MATERIALS and OTHER RESOURCES

TEXTS AND SUPPLEMENTAL BOOKS


RESOURCES

Employer Advisory Board members

CTE Model Curriculum Standards

Local representatives of the IBEW

Representatives/members of the International Association of Electrical Inspectors

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 – Pass the safety test with 100% accuracy.

SECTION B – Basic Electrical Test Equipment – Pass all assignments and exams on basic electrical test equipment with a minimum score of 80% or higher.

SECTION C – Wiring Color Connections – Pass all assignments and exams on wiring color connections with a minimum score of 80% or higher.

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

SECTION E – Blueprint Reading – Pass all assignments and exams on blueprint reading with a minimum score of 80% or higher.
Statement for Civil Rights

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