# Course Outline

**Energy, Environment, and Utilities** **REVISED: January/2018**

**Job Title**
Electrical Powerline Mechanic

**Career Pathway:**
Energy and Power Technology

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

**O*NET-SOC CODE:**
49-9051.00

**CBEDS Title:**
Principles of Power and Energy

**CBEDS No.:**
5577

## 72-75-90

## Powerline Systems/3

**Credits:** 15 **Hours:** 180

**Course Description:**
This competency-based course is the last in a sequence of three designed for powerline technology. It provides students with project-based experiences in advanced powerline theories and techniques. Technical instruction includes an introduction and reviews of workplace safety policies and procedures, resource management, trade mathematics, and employability skills. Emphasis is placed on advanced powerline system applications of direct current (DC), alternating current (AC), capacitance, and inductance. Techniques used for basic electrical wring, advanced rigging, and advanced pole climbing are also emphasized. Instruction on entrepreneurial skills and industry examination preparation is also included. 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 successful completion of the Powerline Systems/2 (72-75-85) 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.

Los Angeles Unified School District
Division of Adult and Career Education
Instructional and Couseling Services Unit
Adult Curriculum Office
www.wearedace.org

## *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** | pp. 7-16 |
| 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** | p. 18 |
| Instructional techniques or methods could include laboratory techniques, lecture method, small-group discussion, grouping plans, and other strategies used in the classroom.<br><br>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.<br><br>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. | pp. 7-16 |
| **EVALUATION PROCEDURES** | pp. 18-19 |
| 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.<br><br>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 ROBERT ESTRADA, ALMA ALVAREZ and ALEJANDRA SALCEDO 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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**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.

## *COMPETENCY-BASED COMPONENTS*
## *for the Powerline Systems /3 Course*

| COMPETENCY AREAS AND STATEMENTS | MINIMAL COMPETENCIES | STANDARDS |
|---|---|---|
| A. INTRODUCTION AND SAFETY<br><br>Review and evaluate classroom and workplace policies and procedures used in accordance with federal, state, and local safety and environmental regulations.<br><br>(3 hours) | 1. Review the scope and purpose of the course.<br>2. Review the overall course content as a part of the Linked Learning Initiative.<br>3. Review classroom policies and procedures.<br>4. Review classroom and workplace first aid and emergency procedures based on the American Red Cross (ARC) standards.<br>5. Review the different occupations in the Energy and Utilities Industry Sector which have an impact on the role of powerline mechanics.<br>6. Review the opportunities available for promoting gender equity and the representation of non-traditional populations in the powerline systems field.<br>7. Review the purpose of the California Occupational Safety and Health Administration (Cal/OSHA) and its laws governing powerline mechanics.<br>8. Review the impact of Environmental Protection Agency (EPA) legislation on the Energy, Environment and Utilities Industry Sector practices.<br>9. Review and demonstrate the procedures for contacting proper authorities for the removal of hazardous materials based on the EPA standards.<br>10. Review the National Electrical Code (NEC) and its role in safeguarding the work conditions of powerline mechanics.<br>11. Review and demonstrate the use of the Material Safety Data Sheet (MSDS) as it applies to the powerline systems.<br>12. Review the role of the Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ in increasing the use of clean and renewable technology in California.<br>13. Review the City of Los Angeles Building and Safety Codes and their applications to the powerline systems.<br>14. Review the provisions of the California Title 24 Energy Efficiency Standards (a.k.a. 2008 California Green Building Standards Code) as they relate to the Energy, Environment and Utilities Industry Sector.<br>15. Pass the safety test with 100% accuracy. | **Career Ready Practice:**<br>1, 3, 6, 8, 9, 11, 12<br><br>**CTE Anchor:**<br>Communications:<br>2.1, 2.2, 2.3, 2.4<br>Problem Solving and Critical Thinking:<br>5.1, 5.4<br>Health and Safety:<br>6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 6.11, 6.12, 6.13, 6.14, 6.15, 6.16<br>Ethics and Legal Responsibilities:<br>8.1, 8.2, 8.3, 8.4, 8.5<br>Leadership and Teamwork:<br>9.6<br>Technical Knowledge and Skills:<br>10.1, 10.2<br><br>**CTE Pathway:**<br>B1.7 |

| COMPETENCY AREAS AND STATEMENTS | MINIMAL COMPETENCIES | STANDARDS |
|---|---|---|
| B. RESOURCE MANAGEMENT REVIEW<br><br>Review resource management principles and techniques applied in the powerline field.<br><br>(1 hour) | 1. Review the definitions of the following:<br>a. resources<br>b. management<br>c. sustainability<br>2. Review the importance of the management of the following resources in the powerline field:<br>a. time<br>b. materials (including sustainable and green)<br>c. personnel<br>3. Review specific examples of effective management of the following resources in the powerline field:<br>a. time<br>b. materials (including sustainable and green)<br>c. personnel<br>4. Review the benefits of effective resource management in the powerline field:<br>a. profitability<br>b. sustainability<br>c. company growth<br>5. Review the economic benefits and liabilities of managing resources in an environmentally responsible way. | **Career Ready Practice:**<br>1, 3, 5, 8,10<br><br>**CTE Anchor:**<br>Communications:<br>2.1, 2.2, 2.3<br>Career Planning and Management:<br>3.2<br>Problem Solving and Critical Thinking:<br>5.1, 5.2, 5.3, 5.4<br>Responsibility and Flexibility:<br>7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7<br>Ethics and Legal Responsibilities:<br>8.1, 8.3, 8.4, 8.5<br>Leadership and Teamwork:<br>9.1, 9.2<br><br>**CTE Pathway:**<br>B1.6, B1.7 |
| C. TRADE MATHEMATICS REVIEW<br><br>Review and apply the mathematical requirements in the powerline field. | 1. Review the practical applications of math in the powerline field.<br>2. Review and demonstrate problem-solving techniques involving whole number problems using arithmetic operations (addition, subtraction, multiplication, and division).<br>3. Review and demonstrate problem-solving techniques involving various fraction problems using arithmetic operations.<br>4. Review and demonstrate problem-solving techniques involving various decimal problems using addition, subtraction, multiplication, and division.<br>5. Review and demonstrate techniques for changing fractions to decimals.<br>6. Review and demonstrate techniques for changing decimals to fractions.<br>7. Review the English and metric systems of measuring length.<br>8. Review the English and metric systems of measuring weight.<br>9. Review the English and metric systems of measuring volume or capacity.<br>10. Review and demonstrate English and metric problem-solving techniques for various measuring problems using arithmetic operations. | **Career Ready Practice:**<br>1, 3, 5<br><br>**CTE Anchor:**<br>Communications:<br>2.1, 2.2, 2.3, 2.4<br>Problem Solving and Critical Thinking:<br>5.1, 5.2, 5.3, 5.4<br><br>**CTE Pathway:**<br>B1.8, B2.4, B7.6 |

| COMPETENCY AREAS AND STATEMENTS | MINIMAL COMPETENCIES | STANDARDS |
|---|---|---|
| (10 hours) | 11. Review and demonstrate English and metric measuring techniques of objects by using tools common to the trade.<br>12. Review expressing metric units in ascending and descending powers of ten.<br>13. Review the conversion of the English numbering system to metric system.<br>14. Review the conversion of the metric system to English numbering system.<br>15. Calculate square roots of English numbers.<br>16. Review and demonstrate problem-solving techniques for geometric problems.<br>17. Review and demonstrate problem-solving techniques for algebraic problems.<br>18. Review and demonstrate problem-solving techniques using percentages.<br>19. Review and demonstrate techniques for reading and interpreting graphs.<br>20. Review and demonstrate techniques for using a calculator.<br>21. Pass utility entry level exam. | |
| D. DIRECT CURRENT (DC) THEORY II<br><br>Understand, apply, and evaluate DC theory as it applies to the trade. | 1. Review the definitions of the following:<br>a. matter<br>b. atoms<br>c. electrons<br>d. molecules<br>e. conductor<br>i. nonmetallic<br>ii. metallic<br>f. electrical charges<br>g. electricity<br>h. electrostatic fields<br>i. dielectric fields<br>j. electrostatic induction<br>k. static electricity<br>l. energy<br>m. potential energy<br>n. kinetic energy<br>o. binding energy<br>p. work<br>q. magnetism<br>r. electromagnetism<br>s. current (a.k.a. amperage)<br>t. direct current (DC)<br>u. voltage<br>v. power (a.k.a. watts)<br>w. resistance (a.k.a. ohms)<br>x. Ohm's Law<br>y. circuit parameters<br>z. simple circuits | **Career Ready Practice:**<br>1, 3, 5<br><br>**CTE Anchor:**<br>Communication:<br>2.1, 2.2, 2.3, 2.4<br>Problem Solving and Critical Thinking:<br>5.1, 5.2, 5.3, 5.4<br>Health and Safety:<br>6.15<br>Technical Knowledge and Skills:<br>10.1, 10.2<br><br>**CTE Pathway:**<br>B1.3, B1.4, B7.3, B7.4, B7.5, B7.6 |

| COMPETENCY AREAS AND STATEMENTS | MINIMAL COMPETENCIES | STANDARDS |
|---|---|---|
| (15 hours) | aa. series circuits<br>bb. parallel circuits<br>2. Review the features and functions of the following:<br>a. resistors<br>b. potentiometers<br>c. switches<br>d. fuses<br>e. relays<br>f. batteries<br>3. Review the following:<br>a. electromagnetic properties<br>b. relationship between electricity and magnetism<br>4. Describe and demonstrate the following:<br>a. construction of a simple electromagnet<br>b. designing direct current circuits with components such as resistors, relays, switches, lamps, batteries, and capacitors, using schematic diagrams<br>c. drawing a schematic diagram from a wiring diagram<br>d. measuring current using a multimeter<br>e. measuring voltage using a multimeter<br>f. measuring resistance using a multimeter<br>g. building an original basic direct current circuit<br>h. using Ohm's Law to calculate circuit parameters for a series circuit<br>i. illustration and construction of a series circuit with a minimum of three resistances<br>j. calculation and measurement of circuit parameters for a series circuit<br>k. using Ohm's Law to calculate circuit parameters for a parallel circuit<br>l. illustration and construction of a parallel circuit with a minimum of three resistances<br>m. calculation and measurement of circuit parameters for a parallel circuit<br>n. using Ohm's Law to calculate circuit parameters for a series-parallel circuit<br>o. illustration and construction of a series-parallel circuit with a minimum of three resistances<br>p. calculation and measurement of circuit parameters for a series-parallel circuit | |
| E. ALTERNATING CURRENT (AC) THEORY II<br><br>Understand, apply, and evaluate AC theory as it applies to the trade. | 1. Review the definitions of the following:<br>a. alternating current (AC)<br>b. waveform<br>c. sine waves<br>d. triangular waves<br>e. square waves<br>f. power ratio<br>g. transformer<br>h. resistive circuit | **Career Ready Practice:**<br>1, 3, 5, 11<br><br>**CTE Anchor:**<br>Communications:<br>2.1, 2.2, 2.3, 2.4 |

| COMPETENCY AREAS AND STATEMENTS | MINIMAL COMPETENCIES | STANDARDS |
|---|---|---|
| (15 hours) | i. phase relationships<br>j. Root Mean Square (RMS)<br>2. Review the following:<br>a. difference between AC and DC<br>b. operation of a basic alternating current signal<br>c. values of sine waves<br>i. instantaneous value<br>ii. average value<br>iii. effective value<br>iv. frequency<br>d. phase relationships of alternating current<br>i. single-phase electricity<br>ii. two-phase electricity<br>iii. three-phase electricity<br>e. relationship of current and voltage<br>f. concept of non-sinusoidal waveforms<br>g. fluctuating DC and AC waveforms<br>h. properties and characteristics of transformers<br>i. reasons for transformer power loss<br>j. application of fixed, variable, multi-tapped, and auto transformers<br>k. common failures of transformers<br>3. Review the features and functions of the following types of transformers:<br>a. step-up transformer<br>b. step-down transformer<br>c. isolation transformer<br>d. autotransformer<br>4. Describe and demonstrate the following:<br>a. computation of the period of AC waveforms<br>b. computation of the frequency of AC waveforms<br>c. peak value of an alternating current signal<br>d. average value of an alternating current signal<br>e. root-mean-square (RMS) value of an alternating current signal<br>f. measurement of AC volts, amps, and resistance<br>g. calculation of resistance in series and parallel AC circuits, and the amount of current flow<br>h. operation of an oscilloscope<br>i. operation of a function generator<br>j. construction and measurement of basic AC circuits<br>k. illustration and construction of a series resistive circuit, calculating parameters and describing phase relationship<br>l. illustration and construction of a parallel resistive circuit, calculating parameters and describing phase relationship<br>m. measurement of the parameters of basic AC circuits<br>n. construction of a transformer<br>o. troubleshooting techniques in isolating common failures of transformers | Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.5<br>Health and Safety: 6.15, 6.16<br>Ethics and Legal Responsibilities: 8.2<br>Technical Knowledge and Skills: 10.1, 10.5<br><br>**CTE Pathway:**<br>B1.1, B1.2, B1.3, B1.5, B1.8, B6.1, B6.2, B6.3, B6.4, B7.1, B7.2, B7.3, B7.4, B7.5, B7.6 |

| COMPETENCY AREAS AND STATEMENTS | MINIMAL COMPETENCIES | STANDARDS |
|---|---|---|
| F. CAPACITANCE II<br><br>Understand, apply, and evaluate the effects of capacitance in direct and alternating current circuits.<br><br>(15 hours) | 1. Review the definitions of the following:<br>a. capacitance<br>b. capacitor<br>c. capacitive circuit<br>2. Review the following:<br>a. three physical factors which determine capacitance<br>b. unit of capacitance<br>c. properties and characteristics of capacitors<br>d. effects of capacitance in DC circuits<br>e. effects of capacitance in AC circuits<br>f. characteristics of various capacitor types<br>g. the effects of a capacitor on series and parallel circuits<br>h. effects of frequency on capacitive reactance<br>i. relationship between phase angle and the values of resistance and capacitance reactance<br>j. impedance<br>k. effect of frequency on impedance<br>l. RC high and low pass filters<br>m. common failures of capacitors<br>3. Describe and demonstrate the following:<br>a. reading the values of a capacitor<br>b. determining the resistance capacitance (RC) time constant for a circuit, given the values of resistance and capacitance<br>c. calculating the value of capacitive reactance given the values of capacitance and frequency<br>d. construction of a capacitor<br>e. illustration and construction of a series capacitive circuit<br>f. illustration and construction of a parallel capacitive circuit<br>g. troubleshooting techniques in isolating the common failures of capacitors | **Career Ready Practice:**<br>1, 3, 4, 5<br><br>**CTE Anchor:**<br>Communications:<br>2.1, 2.2, 2.3<br>Problem Solving and Critical Thinking:<br>5.1, 5.2, 5.3, 5.4<br>Health and Safety:<br>6.15, 6.16<br>Ethics and Legal Responsibilities:<br>8.2<br>Technical Knowledge and Skills:<br>10.1, 10.5<br><br>**CTE Pathway:**<br>B1.7, B6.1, B6.2, B6.3, B6.4, B7.1, B7.3, B7.4, B7.5 |
| G. INDUCTANCE II<br><br>Understand, apply, and evaluate the effects of inductance in DC and AC circuits. | 1. Review the definitions of the following:<br>a. inductance<br>b. inductors<br>c. inductive circuit<br>d. self-induction<br>2. Review the following:<br>a. four physical factors which determine inductance<br>b. unit of inductance<br>c. properties and characteristics of inductors<br>d. effects of inductance in DC circuits<br>e. effects of inductance in AC circuits<br>f. effects of inductance on series and parallel circuits<br>g. effects of frequency on inductive reactance<br>h. relationship between phase angle and inductive reactance<br>i. LR high and low pass filters<br>j. common failures of inductors | **Career Ready Practice:**<br>1, 3, 4, 5<br><br>**CTE Anchor:**<br>Communications:<br>2.1, 2.2, 2.3<br>Problem Solving and Critical Thinking:<br>5.1, 5.2, 5.3, 5.4<br>Health and Safety:<br>6.15, 6.16<br>Ethics and Legal Responsibilities:<br>8.2 |

| COMPETENCY AREAS AND STATEMENTS | MINIMAL COMPETENCIES | STANDARDS |
|---|---|---|
| (15 hours) | 3. Describe and demonstrate the following:<br>a. inductance resistance (LR) time constant for a circuit, given the values of resistance and inductance<br>b. calculate inductive reactance, given the values of inductance and frequency<br>c. basic construction of an inductor<br>d. illustration and construction of a series inductive circuit<br>e. illustration and construction of a parallel inductive circuit<br>f. troubleshooting techniques in isolating common failures of inductors | Technical Knowledge and Skills:<br>10.1, 10.5<br><br>**CTE Pathway:**<br>B1.7, B6.1, B6.2, B6.3, B6.4, B7.1, B7.3, B7.4, B7.5 |
| H. BASIC ELECTRICAL WIRING<br><br>Understand, apply, and evaluate wiring principles and procedures approved by the National Electrical Code (NEC).<br><br>(20 hours) | 1. Define the following electrical service terms:<br>a. transformer<br>b. service drop<br>c. weather head<br>d. mast<br>e. meter base<br>f. disconnect<br>g. panel<br>h. ground<br>2. Describe the following:<br>a. tools and components common to the wiring trade<br>b. commonly used wire sizes in the electrical trade and the amperage rating of each<br>c. proper arrangement of electrical components and hardware in a typical utility-connected installation<br>d. breaker panel components<br>3. Describe the differences between:<br>a. step-up and step-down transformers<br>b. primary and secondary ground<br>c. single-phase and three-phase service installations<br>d. 120v and 240v circuits<br>4. Describe and demonstrate the operation of the following main electrical components:<br>a. inverter<br>b. charge controller<br>c. combiner<br>d. Ground Fault Circuit Interrupter (GFCI)<br>5. Describe and demonstrate the following:<br>a. electrical service wiring techniques<br>b. wiring techniques for typical 120v and 240v residential circuits<br>c. wiring techniques for a sub-fed panel | **Career Ready Practice:**<br>1, 3, 5, 7, 10<br><br>**CTE Anchor:**<br>Communications:<br>2.1, 2.2, 2.3, 2.4<br>Problem Solving and Critical Thinking:<br>5.1, 5.2, 5.3, 5.4<br>Health and Safety:<br>6.1, 6.6, 6.8, 6.9, 6.11, 6.12, 6.13, 6.14, 6.15, 6.16<br>Ethics and Legal Responsibilities:<br>8.2<br>Technical Knowledge and Skills:<br>10.1, 10.2<br><br>**CTE Pathway:**<br>B1.1, B1.3, B1.8, B6.1, B6.2, B6.4, B7.1, B7.3, B7.5 |

| COMPETENCY AREAS AND STATEMENTS | MINIMAL COMPETENCIES | STANDARDS |
|---|---|---|
| I. RIGGING II<br><br>Understand, apply, and evaluate rigging techniques.<br><br>(40 hours) | 1. Review the features and functions of the following ropes:<br>a. 3-strand rope<br>b. plaited rope<br>c. braided rope<br>d. parallel core rope<br>2. Determine the working strength, breaking strength, and safety factor of each type of rope used in rigging.<br>3. Review the proper use and care of synthetic ropes and steel slings.<br>4. Describe and demonstrate the ability to tie the following:<br>a. bowline hitch<br>b. clove hitch<br>c. half hitch<br>d. "trucker's" hitch<br>e. square knot<br>f. timber hitch<br>g. becket bend<br>5. Review the various types of sheaves used in the rigging process.<br>6. Review the proper "block size-to-rope size" ratio.<br>7. Review and demonstrate the following:<br>a. proper "hand-line" operation and preparation<br>b. calculation of simple mechanical advantage problems<br>c. rigging four main transformer gins with their appropriate load capacities<br>d. rigging associated with the use of the A-frame gin<br>e. four ways to install a wooden power pole | **Career Ready Practice:**<br>1, 3, 5, 6, 10<br><br>**CTE Anchor:**<br>Communications:<br>2.1, 2.2, 2.3, 2.4<br>Problem Solving and Critical Thinking:<br>5.1, 5.2, 5.3, 5.4<br>Health and Safety:<br>6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 6.11, 6.12, 6.13<br>Responsibility and Flexibility:<br>7.4, 7.6, 7.7<br>Ethics and Legal Responsibilities:<br>8.2, 8.3<br>Technical Knowledge and Skills:<br>10.1, 10.2<br><br>**CTE Pathway:**<br>B1.1, B1.2, B1.3, B6.1, B6.2, B6.3, B6.4, B7.1 |
| J. POLE CLIMBING AND AERIAL CONSTRUCTION II<br><br>Understand, apply, and evaluate the climbing and pole task techniques while aloft on a wooden power pole. | 1. Review and describe the features and functions of the following:<br>a. various classes of power poles<br>b. pole brand heights<br>2. Practice until mastery the following techniques:<br>a. pole-butt inspection technique<br>b. "two-point" free climbing technique<br>c. "Arkansas" climbing technique<br>d. various types of general construction standards, basic rigging, and aerial construction | **Career Ready Practice:**<br>1, 3, 5, 6<br><br>**CTE Anchor:**<br>Communications:<br>2.1, 2.2, 2.3, 2.4<br>Career Planning and Management:<br>3.1<br>Problem Solving and Critical Thinking:<br>5.1, 5.3<br>Health and Safety:<br>6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.9, 6.11, 6.12, 6.13, 6.14, 6.15, 6.16 |

| COMPETENCY AREAS AND STATEMENTS | MINIMAL COMPETENCIES | STANDARDS |
|---|---|---|
| (40 hours) | | Ethics and Legal Responsibilities: 8.2, 8.3<br>Technical Knowledge and Skills: 10.1, 10.2, 10.5<br><br>**CTE Pathway:** B1.1, B1.2, B1.3, B6.1, B6.2, B6.3, B6.4, B7.1 |
| K. EMPLOYABILITY SKILLS REVIEW<br><br>Understand, apply, and evaluate the employability skills required in the powerline field.<br><br>(3 hours) | 1. Review employer requirements for the following:<br>a. punctuality<br>b. attendance<br>c. attitude toward work<br>d. quality of work<br>e. teamwork<br>f. timeliness<br>g. communication skills<br>h. computer skills and software applications<br>2. Update the list of potential employers through traditional and internet sources.<br>3. Review the role of electronic social networking in job search.<br>4. Update sample résumés and cover letters.<br>5. Review the importance of filling out a job application legibly, with accurate and complete information.<br>6. Complete sample job application forms correctly.<br>7. Review the importance of enthusiasm on a job.<br>8. Review the importance of appropriate appearance on a job.<br>9. Review the importance of the continuous upgrading of job skills.<br>10. Review customer service as a method of building permanent relationships between the organization and the customer.<br>11. Review and demonstrate appropriate interviewing techniques.<br>12. Review the informational materials and resources needed to be successful in an interview.<br>13. Update sample follow-up letters.<br>14. Review and demonstrate appropriate follow-up procedures. | **Career Ready Practice:** 1, 2, 3, 7, 9, 10, 11<br><br>**CTE Anchor:** Communications: 2.1, 2.2, 2.3, 2.4, 2.5<br>Career Planning and Management: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6<br>Technology: 4.1, 4.2, 4.3, 4.6<br>Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4<br>Responsibility and Flexibility: 7.3, 7.4, 7.6, 7.7<br>Ethics and Legal Responsibilities: 8.1, 8.3, 8.4, 8.5<br>Leadership and Teamwork: 9.1, 9.2, 9.3, 9.4, 9.6<br>Technical Knowledge and Skills: 10.1<br>Demonstration and Application: 11.1, 11.2, 11.4, 11.5<br><br>**CTE Pathway:** B1.1, B1.2 |

| COMPETENCY AREAS AND STATEMENTS | MINIMAL COMPETENCIES | STANDARDS |
|---|---|---|
| L. ENTREPRENEURIAL SKILLS<br><br>Understand, apply, and evaluate the process involved in becoming an entrepreneur in the powerline field.<br><br>(3 hours) | 1. Define entrepreneurship.<br>2. Identify the necessary characteristics of successful entrepreneurs.<br>3. Describe the contributions of entrepreneurs to the powerline field.<br>4. Explain the purpose and components of a business plan.<br>5. Examine personal goals prior to starting a business.<br>6. Evaluate sources of monetary investment in a business opportunity.<br>7. Describe various licensing requirements in the photovoltaic field.<br>8. Develop a scenario depicting the student as the photovoltaic business owner.<br>9. Differentiate between LEED business practices and standard business practices. | **Career Ready Practice:**<br>1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12<br><br>**CTE Anchor:**<br>Communications:<br>2.1, 2.2, 2.3, 2.4<br>Career Planning and Management:<br>3.1, 3.2, 3.4, 3.5, 3.6, 3.7, 3.9<br>Technology:<br>4.1, 4.3, 4.4, 4.5<br>Problem Solving and Critical Thinking:<br>5.1, 5.2, 5.3, 5.4<br>Responsibility and Flexibility:<br>7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7<br>Ethics and Legal Responsibilities:<br>8.1, 8.2, 8.3, 8.4, 8.5<br>Leadership and Teamwork:<br>9.1, 9.2, 9.3, 9.4, 9.6, 9.7<br>Technical Knowledge and Skills:<br>10.1, 10.2<br>Demonstration and Application:<br>11.1, 11.2, 11.3, 11.4, 11.5<br><br>**CTE Pathway:**<br>B1.1 |

## *SUGGESTED INSTRUCTIONAL MATERIALS and OTHER RESOURCES*

**TEXTS AND SUPPLEMENTAL BOOKS**

Deb, Anjab K. Powerline Ampacity System: Theory, Modeling and Applications. Taylor and Francis, Inc., 2000.

Shoemaker Thomas M. and James E, Mack. Lineman's and Cableman's Field Manual. McGraw-Hill Companies, 2009.

Shoemaker Thomas M. and James E, Mack. Lineman's and Cableman's Handbook. McGraw-Hill Companies, 2006.

Van Soelen, Wayne. Electrical Essentials for Powerline Workers. Cengage Learning, 2005.

**RESOURCES**

Employer Advisory Board members

CTE Model Curriculum Standards
http://www.cde.ca.gov/ci/ct/sf/documents/energyutilities.pdf

www.americangreenjobs.net

http://www.renewableenergyjobs.com/

http://careers.pennenrgyjobs.com

http://www.cleantechrecruits.com

www.seia.org

www1.eere.energy.gov

**COMPETENCY CHECKLIST**

**METHODS AND PROCEDURES**

A. Lecture and discussion

B. Multimedia presentations

C. Demonstrations and participations

D. Individualized instruction

E. Peer teaching

F. Role-playing

G. Guest speakers

H. Field trips and field study experiences

I. Projects

**EVALUATION**

SECTION A – Introduction and Safety – Pass the safety test with 100% accuracy.

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

SECTION C – Trade Mathematics Review – Pass all assignments and exams on trade mathematics review with a minimum score of 80% or higher.

SECTION D – Direct Current (DC) Theory II – Pass all assignments and exams on direct current (DC) theory II with a minimum score of 80% or higher.

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

SECTION F – Capacitance II – Pass all assignments and exams on capacitance II with a minimum score of 80% or higher.

SECTION G – Inductance II – Pass all assignments and exams on inductance II with a minimum score of 80% or higher.

SECTION H – Basic Electrical Wiring – Pass all assignments and exams on basic electrical wiring with a minimum score of 80% or higher.

SECTION I – Rigging II – Pass all assignments and exams on rigging II with a minimum score of 80% or higher.

SECTION J – Pole Climbing and Working II – Pass all assignments and exams on pole climbing and working II with a minimum score of 80% or higher.

SECTION K – Employability Skills Review – Pass all assignments and exams on employability skills review with a minimum score of 80% or higher.

SECTION L – Entrepreneurial Skills– Pass all assignments and exams on entrepreneurial skills with a minimum score of 80% or higher.

## *Standards for Career Ready Practice*

1. **Apply appropriate technical skills and academic knowledge.**
   Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make connections between abstract concepts with real-world applications and recognize the value of academic preparation for solving problems, communicating with others, calculating measures, and performing other work-related practices.

2. **Communicate clearly, effectively, and with reason.**
   Career-ready individuals communicate thoughts, ideas, and action plans with clarity, using written, verbal, electronic, and/or visual methods. They are skilled at interacting with others: they are active listeners who speak clearly and with purpose, and they are comfortable with terminology that is common to workplace environments. Career-ready individuals consider the audience for their communication and prepare accordingly to ensure the desired outcome.

3. **Develop an education and career plan aligned with personal goals.**
   Career-ready individuals take personal ownership of their educational and career goals and manage their individual plan to attain these goals. They recognize the value of each step in the educational and experiential process, and they understand that nearly all career paths require ongoing education and experience to adapt to practices, procedures, and expectations of an ever-changing work environment. They seek counselors, mentors, and other experts to assist in the planning and execution of education and career plans.

4. **Apply technology to enhance productivity.**
   Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring and using new technology. They understand the inherent risks—personal and organizational—of technology applications, and they take actions to prevent or mitigate these risks.

5. **Utilize critical thinking to make sense of problems and persevere in solving them**
   Career-ready individuals recognize problems in the workplace, understand the nature of the problems, and devise effective plans to solve the problems. They thoughtfully investigate the root cause of a problem prior to introducing solutions. They carefully consider options to solve a problem and, once agreed upon, follow through to ensure the problem is resolved.

6. **Practice personal health and understand financial literacy.**
   Career-ready individuals understand the relationship between personal health and workplace performance. They contribute to their personal well-being through a healthy diet, regular exercise, and mental health activities. Career-ready individuals also understand that financial literacy leads to a secure future that enables career success.

7. **Act as a responsible citizen in the workplace and the community.**
   Career-ready individuals understand the obligations and responsibilities of being a member of a community and demonstrate this understanding every day through their interactions with others. They are aware of the impacts of their decisions on others and the environment around them, and they think about the short-term and long-term consequences of their actions. They are reliable and consistent in going beyond minimum expectations and in participating in activities that serve the greater good.

8. **Model integrity, ethical leadership, and effective management.**
   Career-ready individuals consistently act in ways that align with personal and community-held ideals and principles. They employ ethical behaviors and actions that positively influence others. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the direction and actions of a team or organization, and they recognize the short-term and

long-term effects that management's actions and attitudes can have on productivity, morale, and organizational culture.

9. **Work productively in teams while integrating cultural and global competence.**
Career-ready individuals contribute positively to every team, as both team leaders and team members. To avoid barriers to productive and positive interaction, they apply an awareness of cultural differences. They interact effectively and sensitively with all members of the team and find ways to increase the engagement and contribution of other members.

10. **Demonstrate creativity and innovation.**
Career-ready individuals recommend ideas that solve problems in new and different ways and contribute to the improvement of the organization. They consider unconventional ideas and suggestions by others as solutions to issues, tasks, or problems. They discern which ideas and suggestions may have the greatest value. They seek new methods, practices, and ideas from a variety of sources and apply those ideas to their own workplace practices.

11. **Employ valid and reliable research strategies.**
Career-ready individuals employ research practices to plan and carry out investigations, create solutions, and keep abreast of the most current findings related to workplace environments and practices. They use a reliable research process to search for new information and confirm the validity of sources when considering the use and adoption of external information or practices.

12. **Understand the environmental, societal, and economic impacts of decisions.**
Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact other people, organizations, the workplace, and the environment. They are aware of and utilize new technologies, understandings, procedures, and materials and adhere to regulations affecting the nature of their work. They are cognizant of impacts on the social condition, environment, workplace, and profitability of the organization.

## Statement for Civil Rights

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