

Course Outline

Energy, Environment, and Utilities

REVISED: August/2017

Job Title:

Electrical Powerline Mechanic

79-85-53

Career Pathway:

Energy and Power Technology

Powerline Systems

Industry Sector:

Energy, Environment, and Utilities

Credits: 5

Hours: 90

O*NET-SOC CODE:

49-9051.00

Course Description:

This competency-based course is designed to provide instruction in AC & DC electrical theory, applied mathematics, transmission and distribution of electrical power flow, and industry safety laws pertaining to powerline systems. This course also includes instruction in employability skills and opportunities. 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:

Principles of Power and Energy

Prerequisites:

None.

CBEDS No.:

5577

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

pp. 7-11

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
<p>INSTRUCTIONAL STRATEGIES</p> <p>Instructional techniques or methods could include laboratory techniques, lecture method, small-group discussion, grouping plans, and other strategies used in the classroom.</p> <p>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.</p>	p. 13
<p>UNITS OF STUDY, WITH APPROXIMATE HOURS ALLOTTED FOR EACH UNIT</p> <p>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.</p> <p>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.</p>	Cover pp. 7-11
<p>EVALUATION PROCEDURES</p> <p>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.</p> <p>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.</p>	p. 13
<p>REPETITION POLICY THAT PREVENTS PERPETUATION OF STUDENT ENROLLMENT</p> <p>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.</p>	Cover

ACKNOWLEDGMENTS

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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 Powerline Systems Course

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>A. ORIENTATION, SAFETY, AND PHYSICAL FITNESS</p> <p>Know the importance of good communication, an overall safety conscious attitude, and a physical fit body in the trade.</p> <p>(10 hours)</p>	<ol style="list-style-type: none"> 1. Describe the inherent hazards in the electrical powerline work. 2. Describe the following that help minimize accidents in the field: <ol style="list-style-type: none"> a. safety rules b. operating orders c. illness and injury prevention programs d. safety committees 3. Describe workplace accidents and their contributing factors. 4. Describe proper use of tools and equipment. 5. Describe proper clothing for the job. 6. Pass with 100% accuracy a comprehensive safety exam. 7. Describe the importance of good communication. 8. Participate in the Powerline Athlete Program. 	<p>Career Ready Practice: 1, 2, 3, 5, 6, 7</p> <p>CTE Anchor: Communications: 2.1, 2.2, 2.3, 2.4 Health and Safety: 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 Ethics and Legal Responsibilities: 8.2, 8.3, 8.4 Technical Knowledge and Skills: 10.1, 10.2</p> <p>CTE Pathway: B6.1, B6.4, B7.1</p>
<p>B. APPLIED MATHEMATICS</p> <p>Learn the basic mathematical functions as they apply to the line-working trade.</p> <p>(10 hours)</p>	<ol style="list-style-type: none"> 1. Describe the metric system as it applies to the line-working trade. 2. Describe the decimal system as it applies to the line-working trade. 3. Describe the fractional system as it applies to the line-working trade. 4. Solve various basic math problems in addition, subtraction, multiplication, and division. 5. Transpose three elements formulas. 6. Solve problems using three element formulas. 	<p>Career Ready Practice: 1, 3, 5,</p> <p>CTE Anchor: Communications: 2.1, 2.2, 2.3, 2.4 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4</p> <p>CTE Pathway: B1.8, B7.5</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>C. BASIC ELECTRICAL CONCEPTS</p> <p>Understand magnetism and electron theory.</p> <p>(10 hours)</p>	<ol style="list-style-type: none"> 1. Define the following: <ol style="list-style-type: none"> a. electricity b. static electricity c. magnetism d. electron flow theory e. polarity f. magnetic polarity 2. List five sources of electricity. 3. Describe the operation of a simple battery or cell. 4. Describe polarity as it applies to batteries. 5. Describe the inherent properties of a direct current circuit. 6. Differentiate among conductors, cables, and insulators. 7. Analyze the electron structure of conductors and insulators. 8. List magnetic and nonmagnetic metals. 9. Describe the relationship between magnetism and electricity. 10. Draw a diagram of a basic generator and identify its polarities and outputs. 	<p>Career Ready Practice: 1, 3, 5, 11</p> <p>CTE Anchor: Communications: 2.1, 2.2, 2.3, 2.4 Technical Knowledge and Skills: 10.1</p> <p>CTE Pathway: B1.1, B1.4</p>
<p>D. OHM'S LAW</p> <p>Know the four basic units of Ohm's law as used to solve circuit problems.</p>	<ol style="list-style-type: none"> 1. Define the following: <ol style="list-style-type: none"> a. voltage b. current flow c. resistance d. power e. energy f. Ohm's law 2. List the other names for voltage. 3. List the other names for current flow. 4. Describe the various forms of resistance. 5. Describe work as it is related to Ohm's law. 6. List five elements present in practical electrical circuits. 7. Draw a simple circuit illustrating the principle of Ohm's law. 8. Solve various Ohm's law problems for the following variables: <ol style="list-style-type: none"> a. voltage b. current c. resistance d. power 9. Describe the effects of electrical power. 10. Describe the features of a simple series circuit. 11. Draw a simple series circuit. 12. Describe the rules governing the current and voltage in series circuit. 13. Describe the features of a parallel circuit. 14. Draw a simple parallel circuit. 15. Describe the rules governing the voltage and current in a parallel circuit. 16. Differentiate among the following circuits: <ol style="list-style-type: none"> a. series b. parallel 	<p>Career Ready Practice: 1, 3, 5, 11</p> <p>CTE Anchor: Communication: 2.1, 2.2, 2.3, 2.4 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Technical Knowledge and Skills: 10.1, 10.6</p> <p>CTE Pathway: B1.1, B7.3, B7.5</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(15 hours)	<ul style="list-style-type: none"> c. series-parallel 17. Reduce series-parallel circuits to their simplest forms. 18. Solve various problems relating to series-parallel circuits. 19. Identify commonly used wire sizes in the electrical trade. 20. Describe the relationship between numerical size and physical size of commonly used wire. 21. Identify the common types of insulation encountered in the trade. 	
<p>E. ALTERNATING CURRENT THEORY</p> <p>Learn the alternating current theory as it relates to the trade.</p> <p>(20 hours)</p>	<ol style="list-style-type: none"> 1. Define the following: <ul style="list-style-type: none"> a. Root Mean Square (RMS) b. inductance c. capacitance d. capacitive reactance e. impedance f. power factor 2. Describe the generation of alternating current. 3. Differentiate between the delta electrical system and the wye electrical system. 4. Apply the rules of magnetism and electricity to the generation of the sine wave. 5. Calculate the values of RMS and peak voltages of currents. 6. Describe single-and three-phase power systems and their generation. 7. Differentiate among the following power systems: <ul style="list-style-type: none"> a. DC b. single-phase c. three-phase 8. Describe the units of measure for inductance. 9. Describe transformer action. 10. Compare transformer turns ratio with voltage and current ratios. 11. Describe the general rules of transformer operation. 12. Describe the features of the following types of transformers: <ul style="list-style-type: none"> a. step-up transformer b. step-down transformer c. isolation transformer d. autotransformer 13. Identify the operating conditions important to the transformer. 14. Compare the input and output power of a transformer. 15. Calculate the efficiency of transformers. 16. Describe the nameplate information on transformers. 17. Calculate the input and output currents of transformers. 18. Identify the parts of capacitors. 19. Describe the construction of capacitors. 20. Identify the reasons to minimize power factor. 21. Identify two main methods of reducing power factor. 	<p>Career Ready Practice: 1, 3, 5, 11</p> <p>CTE Anchor: Communications: 2.1, 2.2, 2.3, 2.4 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Technical Knowledge and Skills: 10.1</p> <p>CTE Pathway: B1.4, B7.1, B7.3, B7.5</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>F. POWERLINE SYSTEM</p> <p>Understand the overall power system scheme.</p> <p>(10 hours)</p>	<ol style="list-style-type: none"> 1. Describe the basic structure of utilities power system including the following: <ol style="list-style-type: none"> a. generation b. transmission c. sub-transmission d. distribution of electrical power 2. Differentiate receiving stations from distribution stations. 3. Identify various conductors used in the electrical distribution system. 4. Describe the function of the distribution transformer. 	<p>Career Ready Practice: 1, 3, 5</p> <p>CTE Anchor: Communications: 2.1, 2.2, 2.3, 2.4 Technical Knowledge and Skills: 10.1</p> <p>CTE Pathway: B1.5, B2.2, B6.1, B6.2, B6.4, B7.1</p>
<p>G. RIGGING</p> <p>Understand the overall power system scheme.</p> <p>(10 hours)</p>	<ol style="list-style-type: none"> 1. Define the following based on the type of rope: <ol style="list-style-type: none"> a. inductance b. working strength c. breaking strength d. safety factor 2. Describe the proper use and care of the synthetic ropes and steel slings. 3. Tie the following: <ol style="list-style-type: none"> a. a bowline hitch b. a clove hitch c. a half hitch d. "trucker's" hitch e. square knot f. timber hitch g. becket 4. Identify the various types of sheaves used in the rigging process. 5. Identify the proper "block size-to-rope size" ratio 6. Demonstrate proper "hand-line" operation and preparation. 7. Calculate simple mechanical advantage problems. 8. Identify all the rigging associated with the use of the A-frame gin. 	<p>Career Ready Practice: 1, 3, 5, 7</p> <p>CTE Anchor: Communications: 2.1, 2.2, 2.3 Problem Solving and Critical Thinking: 5.2 Health and Safety: 6.12, 6.16 Technical Knowledge and Skills: 10.1</p> <p>CTE Pathway: B7.1</p>
<p>H. EMPLOYABILITY SKILLS</p> <p>Understand job-seeking procedures.</p>	<ol style="list-style-type: none"> 1. Describe the industry standards for employment. 2. Describe job specifics for various positions. 3. List sources for employment information. 4. Describe working conditions and pay scales. 5. Prepare cover letter and resume. 6. Complete application forms. 7. Role-play basic interview skills. 8. Describe work habits required to hold a job. 	<p>Career Ready Practice: 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12</p> <p>CTE Anchor: Communications: 2.1, 2.2, 2.3, 2.4, 2.5</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(5 hours)		Career Planning and Management: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9 Technology: 4.1 Problem Solving and Critical Thinking: 5.1, 5.4 Responsibility and Flexibility: 7.3, 7.4, 7.5, 7.6, 7.7, 7.8 Ethics and Legal Responsibilities: 8.1, 8.3, 8.4, 8.5 Leadership and Teamwork: 9.6 Technical Knowledge and Skills: 10.1 CTE Pathway: 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.pennenergyjobs.com>

<http://www.cleantechrecruits.com>

www.seia.org

www1.eere.energy.gov

COMPETENCY CHECKLIST

TEACHING STRATEGIES and EVALUATION

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 – Orientation, Safety, and Physical Fitness – Pass the safety test with 100% accuracy.

SECTION B – Applied Mathematics – Pass all assignments and exams on applied mathematics with a minimum score of 80% or higher.

SECTION C – Basic Electrical Concepts – Pass all assignments and exams on basic electrical concepts with a minimum score of 80% or higher.

SECTION D – Ohm’s Law – Pass all assignments and exams on Ohm’s Law with a minimum score of 80% or higher.

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

SECTION F – Powerline System – Pass all assignments and exams on powerline system with a minimum score of 80% or higher.

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

SECTION H – Employability Skills– Pass all assignments and exams on employability skills 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.
