

Course Outline

Energy, Environment, and Utilities

REVISED: August/2017

Job Title
Electrician

72-75-60

Career Pathway:
Energy and Power Technology

Electrician/3: Wiring Techniques

Industry Sector:
Energy, Environment, and
Utilities

Credits: 20

Hours: 240

O*NET-SOC CODE:
47-2111.00

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.

CBEDS Title:
Introduction to Electrical Power
Systems

Prerequisites:

Enrollment requires completion of the Electrician/2: Wiring and Codes (72-75-55) 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. 7-10

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

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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/3: Wiring Techniques Course

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>A. WORKPLACE SAFETY</p> <p>Understand, apply, and evaluate the safety practices and approved materials for the industry.</p> <p>(10 hours)</p>	<ol style="list-style-type: none"> 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. 	<p>Career Ready Practice: 1, 6</p> <p>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</p> <p>CTE Pathway: B4.1</p>
<p>B. BASIC ELECTRICAL TEST EQUIPMENT</p> <p>Understand, apply, and evaluate the techniques for the selection and utilization of electrical instrumentation.</p>	<ol style="list-style-type: none"> 1. Describe the basic meter theory. 2. Identify the following: <ol style="list-style-type: none"> a. multimeters b. meggers c. clamp-on meters d. analog meters e. digital meters 3. Describe the features and functions of the following: <ol style="list-style-type: none"> a. multimeters b. meggers c. clamp-on meters 4. Describe the proper use of the following: <ol style="list-style-type: none"> a. multimeters b. meggers c. clamp-on meters 5. Demonstrate the proper procedures for storing and maintaining the following: <ol style="list-style-type: none"> 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. 	<p>Career Ready Practice: 1, 3, 4, 5, 11</p> <p>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</p> <p>CTE Pathway: B7.3, B7.4</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(40 hours)	<ol style="list-style-type: none"> 10. Demonstrate the accurate interpolation of readings on the analog meter. 11. Describe the features and functions of the following: <ol style="list-style-type: none"> a. digital instruments b. analog instruments 12. Demonstrate the proper selection procedures for a required meter and range for a given problem. 13. Describe the features and functions of the following specialty instruments: <ol style="list-style-type: none"> a. the Wiggy b. clamp-on ammeter c. Tic-tracer d. watt-meter e. frequency meter 14. Describe the features and functions of the following: <ol style="list-style-type: none"> a. voltmeter/ammeter b. ohmmeter 15. Demonstrate the proper testing procedures using the following: <ol style="list-style-type: none"> a. voltmeter/ammeter b. ohmmeter 16. Demonstrate the proper acceptance testing procedures for cables. 17. Demonstrate the proper maintenance testing procedures for generators. 18. Demonstrate the proper insulation test procedures for a megohmmeter. 19. Describe the features and functions of high voltage cable and insulators. 20. Demonstrate the proper method when checking the integrity of insulation. 21. Describe the special requirements for high voltage testing. 22. Demonstrate the use of 'no contact' voltage indicators. 23. Demonstrate the appropriate tests used for instrumentation. 24. Demonstrate the appropriate methods used for instrumentation. 25. Demonstrate the appropriate voltages used for instrumentation. 26. Demonstrate the appropriate equipment used for instrumentation. 	
<p>C. WIRE COLOR CONNECTIONS</p> <p>Understand, apply, and evaluate the techniques for proper interpretation of wire color connections.</p>	<ol style="list-style-type: none"> 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. 	<p>Career Ready Practice: 1, 3</p> <p>CTE Anchor: Communications: 2.1, 2.2, 2.3 Health and Safety: 6.1, 6.11, 6.16 Ethics and Legal Responsibilities: 8.2</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>E. BLUEPRINT READING</p> <p>Understand, apply, and evaluate the types, features, and functions of blueprint drawings and prints.</p> <p>(30 hours)</p>	<ol style="list-style-type: none"> 1. Identify the use of the following information blocks: <ol style="list-style-type: none"> a. title block b. change block c. gear and spline data d. notes 1. Explain what is meant by views or projections. 2. Identify the following types of lines: <ol style="list-style-type: none"> a. outline or visible b. section c. hidden d. center e. dimension f. cutting plane g. break lines 3. Explain how the following terms apply to dimension: <ol style="list-style-type: none"> a. fractional b. decimal c. angular 4. Explain how the following terms apply to tolerance: <ol style="list-style-type: none"> a. fractional b. decimal c. angular 5. Identify the symbols and abbreviations used in blueprint reading. 6. Demonstrate the accurate use of architectural prints. 7. Describe the creation of the following: <ol style="list-style-type: none"> a. blueprints b. plans c. specifications 8. Identify the different types of symbols used in electrical and related trades. 9. Describe the functions of basic line types. 10. Identify drawing tools and techniques. 11. Recognize and apply dimensions to the drawings. 12. Prepare 'as built' drawings. 13. Describe the features and functions of the following: <ol style="list-style-type: none"> a. wiring diagrams b. line diagrams c. schematics d. ladder diagrams 14. Describe the use of blueprint specifications. 15. Describe the functions of the various types of: <ol style="list-style-type: none"> a. plots b. sections c. details d. schedules e. specification sheets f. addendums and revisions 	<p>Career Ready Practice: 1, 2, 3, 5, 11</p> <p>CTE Anchor: Communications: 2.1, 2.2, 2.3, 2.4, 2.5 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Ethics and Legal Responsibility: 8.2 Technical Knowledge and Skills: 10.1, 10.2</p> <p>CTE Pathway: B7.6</p>

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, 3rd 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

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.
