

YOSEMITE REGIONAL OCCUPATIONAL PROGRAM

ELECTRICAL TECHNOLOGY

CBEDS Codes: 5512

JOB TITLES

Electrical Repairer

ELECTRICIAN (construction)

ELECTRICIAN (mfd. bldgs.)

DOT NO.

829.261-018

824.261-010

824.681-010

Course description: An instructional program that prepares individuals to install, operate, maintain, and repair electrically energized systems in residential and light commercial settings. The course prepares the student for entry level employment in electrical trades, for electronics theory classes, additional ROP courses, trade schools, or post secondary institutions. The content of the course can be linked to the Tech Prep and School-to-Work programs, and can be used to develop career paths for students.

Recommended Prerequisites: Electronics 1-2 and course in Algebra or Math I. Academic deficiencies will be addressed during the course.

DURATION: 360 total hours

CREDIT: 5-10 units/semester

MEETS UNIVERSITY OF CALIFORNIA ENTRANCE REQUIREMENTS: No

MEETS CALIFORNIA STATE UNIVERSITY REQUIREMENTS: No

ARTICULATED WITH POSTSECONDARY INSTITUTIONS: None

INSTRUCTIONAL MATERIALS

Basic Text(s):

Wiring 1-2-3: Second Edition Steve Cory, Meredith Publishing 2005

Electrical Wiring, Residential: Ninth Edition Ray C. Mullin, Delmar Publishers, Inc. 1990

Supplementary Text(s):

Electricity I and Electricity 2, Fourth Edition, Thomas Kubalan, Delmar Publishers, Inc. 1987

Electricity I: Study Guide. David H. Thomas and Willard L. Sexton, Delmar Publishers, Inc. 1987

National Electrical Code Blueprint Reading: Tenth Edition, K.L. Gebert, American Technical Publishers, 1987
NEC

National Electrical Code for One or Two Family Dwellings, Current Edition, National Fire Protection
Association, NFPA 70A

Practical Problems in Mathematics for Electricians, Fourth Edition, Garrard and Herman, Delmar Publishers,
1990

Practical Problems in Mathematics for Electronics Technicians, Delmar Publishers, Inc. 1990

Electricians Guide to Conduit Bending, Richard A. Cox, Pen Oreille Publications, 1982

Electrical Wiring, Third Edition with 1987 NEC Code Addendum, J. Howard Turner, Editor, American
Association for Vocational Instructional Materials, 1989

Bergwall VHS videocassettes:

#803X-X9	Electrical House Wiring Explained
#818X-X9	Rigid Electrical Conduit

Instructional Content Instruction will include:	Student Outcomes At the end of instruction, the student will be able to:	Hours CL=Classroom CC=Comm. Class			
		CTE	Anchor & CR	CL	CC
<p>Electrical Career Opportunities.</p> <ol style="list-style-type: none"> Discuss components of Electrical trades Discuss electrical terminology and definitions Review teacher/student responsibilities to program. Review four basic phenomena on which electricity is based. History of the progression of electricity and electrical trades Unit names of electrical/electronic quantities History of workforce progression in America. Apprentice/entry level technician Electrical Trades Ethics Continuing education programs Employment opportunities in Electrical Trades. 	<p>Goal: The student will demonstrate knowledge of course content, skills to be obtained in the course of study, why electrical trades is a good field of employment, and fundamental knowledge about the field of computer related servicing.</p> <ol style="list-style-type: none"> Select true statements about the contents of this course. Select true statements about the technical-industrial team. Match terms associated with expectations of the electrical field to their definitions or descriptions. List teacher and student responsibilities in the electrical program. State the four basic phenomena on which electricity is based. List the historical persons and companies largely responsible for the progression of electricity and electrical trades. Explain how the unit names of many electrical and electronic quantities were derived. Describe the historical progression of events affecting the work force of America. List the areas of work in which the apprentice/entry level technician becomes involved. Discuss the ethics of the electrical trades. Describe apprenticeship programs as they apply locally and discuss the values of such programs. Discuss programs available through trade schools and post-secondary institutions and their value. State four good reasons why the electrical field is a good place for employment. 		<p>3.0-3.9</p> <p>CR 3</p>	<p>On-going 2'0</p>	
<p>2. Career Opportunities</p> <ol style="list-style-type: none"> Discuss personality traits. Define interests to present to an employer. Define skills learned in electrical trades Discuss career choices. 	<p>Goal: The student will be able to demonstrate competency in lifelong career planning skills, develop leadership abilities, and develop an awareness of programs offered in higher education without regard to race, sex, national origin or handicap as they relate to electrical trades</p> <ol style="list-style-type: none"> Identify personal traits (strengths, values, and weaknesses). Identify personal interests to discuss with an employer. Write five skills learned in electrical trades which transfer to a job. Identify at least four possible career choices in the electrical trades. 		<p>3.0-3.9</p> <p>CR 3</p>	<p>On-going 20</p>	

Instructional Content Instruction will include:	Student Outcomes At the end of instruction, the student will be able to:	Hours CL=Classroom CC=Comm. Class			
		CTE	Anchor & CR	CL On-going	CC
<p>Career Opportunities Cont.</p> <p>5. Discuss and define career opportunities within electrical trades without regard to race, sex, national origin, or handicap.</p> <p>6. Discuss earning potential within electrical trades.</p> <p>7. Discuss personal traits and skills that an employer would find valuable.</p>	<p>D. Identify at least four possible career choices in the electrical trades.</p> <p>E. Demonstrate that opportunities in the electrical trades are available without regard to race, sex, national origin, or handicap.</p> <p>F. Compare the earnings and working conditions of production workers in the electrical trades to other like industries.</p> <p>G. Select true statements concerning personal traits and skills important for successful electricians.</p>		9.0		
<p>3. Job Search Skills</p> <p>1. Terminology</p> <p>2. Employment openings</p> <p>3. Job Application</p> <p>4. Employer expectations</p> <p>5. Job interview conduct</p> <p>6. Resume preparation</p> <p>7. Proper letter structure and good written communication skills</p>	<p>Goal: The student will demonstrate knowledge of job search and interviewing skills to successfully find employment.</p> <p>A. Match terms associated with applying for a job with correct definitions.</p> <p>B. List sources for locating job openings.</p> <p>C. List three methods of applying for a job.</p> <p>D. Select information requested on an application form.</p> <p>E. Distinguish between employer and employee expectations.</p> <p>F. Demonstrate attributes and attitudes desired by employers during personal interviews.</p> <p>G. Demonstrate proper conduct during a job interview.</p> <p>H. Prepare a resume</p> <p>I. Develop a letter of application</p> <p>J. Complete an application form for a job in electrical trades, or electronics technology.</p>		3.0-3.9	On-going 10	
<p>4. Electrical Careers: Employer Expectations</p> <p>1. Discuss and demonstrate behaviors valued by employers.</p>	<p>Goal: The student will understand and demonstrate attitudes, behaviors, and personal characteristics valued by employers.</p> <p>A. Responsibility</p> <p>B. Dependability</p> <p>C. Promptness</p> <p>D. Willingness to learn new skills</p> <p>E. Attentiveness during instruction</p> <p>F. Getting along with others</p> <p>G. Honesty and integrity</p> <p>H. Pride in work</p> <p>I. Flexibility</p> <p>J. Not being defensive when corrected</p> <p>K. Working up to capacity</p> <p>L. Being pleasant and cheerful</p> <p>M. Showing strong motivation to succeed</p> <p>N. Good personal appearance</p> <p>O. Organized</p> <p>P. Constructively assisting others</p>		3.0-3.9 7.0 8.4 9.2-9.7 CR 7	On-going 6	

Instructional Content Instruction will include:	Student Outcomes At the end of instruction, the student will be able to:	Hours CL=Classroom CC=Comm. Class			
<p>5. Orientation: Tools</p> <ol style="list-style-type: none"> 1. Terminology 2. Electrical hand tools 3. Power Tools and their uses 4. Proper selection of tools for the right job. 5. Use of a multimeter 6. Voltage measurements 7. Define "out-of-circuit" 8. Proper care and maintenance of tools. 	<p>Goal: The student will demonstrate knowledge of electrical construction equipment such as power tools and electrical hand tools, test equipment and how to use them properly and safely, and how to care for them.</p> <ol style="list-style-type: none"> A. Define the term "hand tool." B. State the two most important hand tools that should be available in the electrician's tool pouch at all times. C. Identify common electrical hand tools. D. Match tools to their uses. E. List factors to consider when selecting tools. F. Use multimeters to check continuity and make voltage measurements. G. Use "out-of-circuit" ammeters to measure alternating H. List maintenance procedures for tools. 	CTE	Anchor & CR 10.1-10.5	CL On-going 14	CC
<p>6. Orientation: Safety</p> <ol style="list-style-type: none"> 1. Terminology 2. Equipment hazards 3. Shop Safety 4. Fire safety 5. First aid 6. Fire extinguisher operation 7. OSHA regulations and codes 8. General Safety 9. Personal Safety 10. Electrical Cords 11. Safety when using "Hot" equipment. 12. Battery Charging 13. Shop safety test 14. Parental acknowledgement of safety and conduct expectations. 	<p>Goal: The student will demonstrate knowledge of hazards of working with electrical and electronic systems and state the use and method of operation for common types of fire extinguishers. Demonstrate safe handling of hand and power tools and electrical cords.</p> <ol style="list-style-type: none"> A. Match terms associated with electrical safety. B. Name four hazards of working with electrical and electronics equipment. C. Demonstrate shop safety D. Discuss correct procedure when treating an electrical shock victim. E. Match four classes of fire with the type of fire each identifies. F. State the use and operation of four common fire extinguishers. G. Match the five colors designated by OSHA or industry used in color coding with the type of hazard they represent. H. Describe good general lab safety rules. I. Describe good personal safety rules. J. Demonstrate good hand and power tool safety. K. Demonstrate safe use of electrical cords. 		10.0-10.5	On-going 22	

Instructional Content Instruction will include:	Student Outcomes At the end of instruction, the student will be able to:	Hours CL=Classroom CC=Comm. Class			
		CTE	Anchor & CR	CL	CC
6. Orientation: Cont.	L. State safety practices to be observed near rotating machinery. M. State safety practices to be used when working on electronic equipment. Include practices for "hot" equipment. N. Satisfactorily complete the district's safety program. O. Pass shop safety tests. Q. Obtain parental acknowledgement of safety requirements and conduct expectations.				
7. Electrical Mathematics. 1. Fractions in relationship to electrical problems. 2. Decimals 3. English and Metric measurement systems. 4. Percentages 5. Ohm's Law 6. Positive and negative numbers. 7. Formulas 8. Exponents 9. Demonstrate Ohm's Law 10. Metric prefixes.	Goal: The student will demonstrate competency in electrical/electronics mathematics. A. Solve electrical problems using fractions. B. Convert fractions to decimals and decimals to fractions. C. Measure objects; determine answers in metric and English systems of measurement. D. Add and subtract decimals and convert to decimals. E. Convert decimals to percentages. F. Use Ohm's Law to determine electrical quantities. Multiply and divide as necessary. G. Solve problems containing positive and negative numbers. H. Solve complex formulas containing addition, subtraction, multiplication and division. I. Solve problems containing negative exponents. J. Use metric prefixes in place of large and small numbers.	D2.0 D2.1 D2.3 D2.8 D2.9	5.1	2	
8. Electron Theory 1. Discuss and define fundamental properties of matter. 2. Structure of an atom. 3. Basic electrical concepts.	Goal: The student will demonstrate competency in understanding the fundamentals of electron theory and Ohm's Law. A. List the fundamental properties of matter. B. Describe the structure of an atom. C. Explain the basic electrical concepts of current, voltage, resistance, and electrical polarity. D. State and define Ohm's Law.	D2.0 D2.8	5.0 5.1 5.2	2	
9. Circuits 1. Define the relationships of voltage, current, and resistance in a series circuit. 2. Parallel circuit 3. Parallel resistance problems and how to solve them. 4. Characteristics of series-parallel circuits.	Goal: The student will demonstrate competency in understanding series, parallel, and series-parallel circuits. A. Describe the basic relationships of voltage, current, and resistance in a series circuit. B. Describe the basic relationships of a parallel circuit. C. Solve parallel resistance problems. D. Explain the characteristics of series-parallel circuits. E. Demonstrate procedures for solving series-parallel circuit problems.	C7.0 C7.1 C7.4	11.1	8	

Instructional Content Instruction will include:	Student Outcomes At the end of instruction, the student will be able to:	Hours			
			CL=Classroom CC=Comm. Class		
10. Electrical Energy and Power 1. Define relationship of work to power. 2. Parallel circuits 3. Parallel resistance problems.	Goal: The student will demonstrate competency in understanding electrical energy and power. A. Discuss the relationship of work to power. B. Describe the basic relationships of a parallel circuit. C. Solve parallel resistance problems.	C7.1 C7.3 C7.4	Anchor/ CR 5.2	CL 10	CC
11. Electrical conductors 1. Define circuit resistance. 2. Define conductor resistance. 3. Define American Wire Gauge.	Goal: The student will demonstrate competency in understanding electrical conductors and wire sizes. A. State five factors that contribute to total resistance in a circuit and the part which conductors contribute to that resistance. B. Explain the American Wire Gauge (AWG) table and how to use it.	C7.1 C7.3 C7.4	5.3	4	
12. Alternating current 1. Define the characteristics of alternating current. 2. Discuss the generation of alternating current. 3. Define terminology related to alternating current. 4. Define "effective value" of alternating current.	Goal: The student will demonstrate competency in understanding how alternating current is generated and measured and define related terms. A. Discuss the characteristics of alternating current. B. Describe the generation of alternating current. C. Define the terminology related to alternating current. D. Define "effective value" of alternating current.	C7.1	5.3	4	
13. Voltage and Current 1. Voltage relationship 2. AC series circuits 3. Voltage and current 4. Resistance, inductance, and capacitance connected in series.	Goal: The student will develop competency in understanding the relationships of voltage and current in a series resistive-inductive, in a series resistive-capacitive, and in a series resistive-capacitive-inductive circuit. A. Explain the current voltage relationship in an AC series circuit containing resistance and inductance. B. Describe the relationships of voltage and current in a series circuit containing resistance and capacitance. C. Discuss the effects of a combination of resistance, inductance, and capacitance connected in series.	C7.2 C7.3 C7.4	1.0 5.3	4	
14. Reading and Interpreting Electrical Drawings 1. Identify contents of a complete set of electrical working drawings. 2. Discuss categories of electrical drawings. 3. Demonstrate a floor plan. 4. Identify 20 symbols commonly used on electrical drawings. 5. Discuss the four basic types of building drawings.	Goal: The student will demonstrate competency in reading and interpreting electrical drawings, wiring diagrams, and specifications for residential and light commercial electrical construction. A. List the contents of a complete set of electrical working drawings. B. List three categories of electrical drawings. C. Layout a floor plan for a simple electrical installation. D. Identify 20 symbols commonly used on electrical working drawings. E. List the four basic types of building drawings usually found as part of electrical working prints.	D3.0 D3.1 D3.2 D3.3 D3.4	10.1	16	

Instructional Content Instruction will include:	Student Outcomes At the end of instruction, the student will be able to:	Hours CL=Classroom CC=Comm. Class			
<p>15. National Electrical Code (NEC)</p> <ol style="list-style-type: none"> 1. Discuss NEC. 2. Discuss and define Article 90. 3. Discuss and define article 100 4. Identify grounded circuit conductor 5. Demonstrate how to wire branch circuits. 6. Define article 220 and how to calculate load for a residence. 7. Article 310 and branch circuit wire size. 8. Demonstrate types sheathed non-metallic (NM) and service entrance (SE) cable. 9. Underground feeder (UF) cable. 10. Use of Tables to determine conduit fill. 11. Use of Table 8 to determine wire dimensions and resistance. 	<p>Goal: Demonstrate competency in using the National Electrical Code (NEC)</p> <ol style="list-style-type: none"> A. Understand the introduction to the NEC found in Article 90. B. Find and use definitions for NEC terms using Article 100 as a resource. C. Identify the grounded circuit conductor by using Article 200. D. Determine how to wire branch circuits and devices according E. Use Article 220 to calculate total load for a residence. F. Determine how to install types sheathed non-metallic (NM) and service entrance (SE) cable by using Article 336. G. Discuss type underground feeder (UF) cable and its use according to Article 339. H. Use Tables 3A, 3B, and 3C of Chapter 9 to determine conduit fill. I. Use Table 8 of Chapter 9 to determine wire dimensions and resistance. 	<p>CTE</p> <p>D11.3 D11.5 D11.6 D11.1</p>	<p>Anchor/ CR</p> <p>10.1</p>	<p>CL</p> <p>On-going 10</p>	<p>CC</p>
<p>16. Circuits: Residence</p> <ol style="list-style-type: none"> 1. Calculate occupied floor area in a drawing. 2. Define total load requirements in amperes. 3. Define minimum number of lighting branch circuits required. 4. Demonstrate use of the National Electrical Code. 	<p>Goal: The student will develop competency in determining the number of circuits required in a residence.</p> <ol style="list-style-type: none"> A. Calculate the occupied floor area of a drawing. B. Determine the total load requirements in amperes for general lighting. C. Determine the minimum number of lighting branch circuits required. D. Calculate the number of small appliance branch circuits required. E. Use the National Electrical Code to determine the basic requirements for various branch circuits in a dwelling. 	<p>B&C D3.1- D3.5</p> <p>D2.0 D2.1 D2.3 D2.6 D2.8</p>	<p>5.2 5.4</p>	<p>14</p>	

Instructional Content Instruction will include:	Student Outcomes At the end of instruction, the student will be able to:	Hours CL=Classroom CC=Comm. Class			
		CTE	Anchor/ CR	CL	CC
<p>17. Electrical requirements: Bedroom, Bath, Kitchen, Living Room, Laundry, Garage and Exterior lighting.</p> <ol style="list-style-type: none"> Demonstrate grouping outlets into circuits. Estimate loads Draw a cable layout and wiring diagram based on information given in the plans to specifications. Proper wall box and installation Wall boxes and how they are grounded. Installation of fixtures in a clothes closet. Ground-fault circuit interrupters (GFCI). Outlet connection Load shift from one circuit to another. Probably connected wattage for a room based on fixtures and outlets. 	<p>Goal: The student will demonstrate competency in determining electrical requirements for bedroom lighting.</p> <ol style="list-style-type: none"> Explain the factors which influence the grouping outlets into circuits. Estimate loads for the outlets of a circuit. Draw a cable layout and a wiring diagram based on information given in the residence plans, the specifications, and NEC requirements. Select the proper wall box for a particular installation. Explain how wall boxes can be grounded. List the requirements for the installation of fixtures in clothes closets. Explain the operation and connection of ground-fault circuit interrupters (GFCI). Explain how outlets in one room can be connected to a circuit in another room to shift the load from one circuit to another. Estimate the probable connected wattage for a room based on the number of fixtures and outlets included in the circuit supplying the room. 	D2.9 D11.0	5.3 5.4 10.1	8	
<p>18. Heat and Smoke Detectors.</p> <ol style="list-style-type: none"> Identify smoke detectors. Location and installation requirements for detectors. Wiring requirements for heat and smoke detectors. 	<p>Goal: The student will demonstrate competency in understanding installation techniques for heat and smoke detectors.</p> <ol style="list-style-type: none"> Name the two basic smoke detectors. Discuss the location requirements for the installation of heat and smoke detectors. List the locations where heat and smoke detectors may not be installed. Describe the wiring requirements for installation of heat and smoke detectors. 	D11.3 D11.4	10.1		
<p>19. Service entrances and equipment</p> <ol style="list-style-type: none"> Define electrical service, overhead service, service drop, and underground service. Describe various NEC sections covering installation. Discuss NEC requirements for disconnection of electrical service. Discuss grounding of interior AC systems. 	<p>Goal: The student will demonstrate competency in understanding installation techniques of service entrances and equipment.</p> <ol style="list-style-type: none"> Define electrical service, overhead service, service drop and underground service. List the various NEC sections covering the installation of a mast-type overhead service and an underground service. Discuss the NEC requirements for disconnecting the electrical service using a main panel and load centers. Discuss the grounding of interior AC systems and the bonding of all service entrance equipment. 	D11.3 D11.4	10.1		

Instructional Content Instruction will include:	Student Outcomes At the end of instruction, the student will be able to:	Hours			
		CL=Classroom	CC=Comm. Class		
20. Service entrance calculations <ol style="list-style-type: none"> 1. Discuss calculated load of the residence using the methods of NEC Article 220. 2. Calculate size of the service-entrance conductors. 3. Demonstrate use of a phase watt-hour meter. 	Goal: The student will demonstrate competency in understanding service entrance calculations and how to read the watt-hour meter. <ol style="list-style-type: none"> A. Determine the total calculated load of the residence using the methods of NEC Article 220. B. Calculate the size of the service-entrance conductors, including the size of the neutral conductor. C. Demonstrate ability to read a typical single phase or three-phase watt-hour meter. 	CTE D2.1 D2.9 D11.3	Anchor/ CR 5.3 5.4 10.1	CL	CC
21. Service entrances and equipment <ol style="list-style-type: none"> 1. Define electrical service, overhead service, service drop, and underground service. 2. Describe various NEC sections covering installation. 3. Discuss NEC requirements for disconnection of electrical service. 4. Discuss grounding of interior AC systems. 	Goal: The student will demonstrate competency in understanding installation techniques of service entrances and equipment. <ol style="list-style-type: none"> A. Define electrical service, overhead service, service drop and underground service. B. List the various NEC sections covering the installation of a mast-type overhead service and an underground service. C. Discuss the NEC requirements for disconnecting the electrical service using a main panel and load centers. D. Discuss the grounding of interior AC systems and the bonding of all service entrance equipment. 	D3.1 D11.3	10.1		CC
22. Service entrance calculations <ol style="list-style-type: none"> 4. Discuss calculated load of the residence using the methods of NEC Article 220. 5. Calculate size of the service-entrance conductors. 6. Demonstrate use of a phase watt-hour meter. 	Goal: The student will demonstrate competency in understanding service entrance calculations and how to read the watt-hour meter. <ol style="list-style-type: none"> D. Determine the total calculated load of the residence using the methods of NEC Article 220. E. Calculate the size of the service-entrance conductors, including the size of the neutral conductor. F. Demonstrate ability to read a typical single phase watt-hour meter. 	D2.9	10.1		
23. New Technology <ol style="list-style-type: none"> 1. Discuss and demonstrate new methods, materials and equipment that coincide with the electrical and electronic trades. 	Goal: The student will demonstrate competency in new emerging technology. <ol style="list-style-type: none"> A. Identify the new methods, materials and equipment that coincide with the electrical/electronic trades. B. Discuss the computer age and its effects on the electrical/electronics trade. 		4.5	20	