



Electrical Maintenance Course Outline

Course Description

This yearlong 519 hour Electrical Maintenance course covers all aspects of electricity and its many uses. Students will learn current wiring methods and up-to-date safety protocol as well as troubleshooting circuits using state-of-the-art equipment. Students will wire both residential and commercial electrical devices learning and utilizing current NEC codes through the use of project boards, campus projects and the SVCTE Project House. Students will gain experience in conduit bending, connecting and operating various types of switching devices, receptacles, circuits, and service equipment used in the electrical trades. Students will draw and interpret schematics and blueprints, as well as be introduced to solar, motor controls, transformers, and relays. In addition, students will learn employability and communication skills.

Course Details

Length of Program and Academic Credits Earned:

Year-long 3 hour course = 519 hours total (~261/semester)

30 total credits (15/semester):

- 20 non-a-g elective credits (10/semester)
- 10 UC a-g "c" credits (5/semester)

Pre-Requisites:

- High School Junior or Senior, or 16 years or older

CTE Classification:

- **Industry Sector:** Building and Construction Trades
- **Industry Pathway:** Residential and Commercial Construction
- **CA Basic Education Data System (CBEDS) Code:** 5502

Work-Based Learning:

Authentic, experiential projects on campus may be available to students meeting certain criteria

Certifications & State Tests:

- ET Card - State Approved Course
- Morell Tools: Each student that meets the Morell Foundation requirements will receive their own set of professional tools to take with them upon completion
- SVCTE Certificate of Completion awarded with "C" or better average for both semesters.
- Lock out - Tag out Certificate

Community College Articulations

Students completing the Electrical Technology course with a grade of “B” or better may be granted college credits at the following community college:

San Jose City College – 3.0 units – Electrician Trainee Program

More info and application: www.sjcc.edu/academics/departments-divisions/electrician-trainee

Possible Education & Career Pathways

For more career information: www.onetonline.org

College & Career Pathways:	Career Opportunities	O*NET Codes
<u>Post-Secondary:</u> Students with a high school diploma and having successfully completed this course have a number of entry-level career opportunities, as well as continuing their education.	<ul style="list-style-type: none"> ● Helpers — Electricians 	47-3013.00
<u>Continuing Education: Including Community College, Training Programs, Certifications, etc:</u> <ul style="list-style-type: none"> ● Apprenticeship programs ● Certification programs ● AA or AS in related field 	<ul style="list-style-type: none"> ● Electrician ● Electrical and Electronic ● Electrical Powerline Installer/Repair ● Electrical Engineering Technologist 	47-2111.00 49-2093.00 49-9051.00 14-3029.02
<u>University Majors & Degrees:</u> <ul style="list-style-type: none"> ● BA or BS in electrical engineering or related field 	<ul style="list-style-type: none"> ● Electrical Engineers ● Solar Energy System Engineers 	17-2071.00 17-2199.11
<u>Post-Baccalaureate Degrees</u> <ul style="list-style-type: none"> ● Masters or Doctorate in electrical engineering or related field 	<ul style="list-style-type: none"> ● Electrical Engineers ● Nanosystems Engineers 	17-2071.00 17-2199.09

Ongoing Unit: Career Readiness & Professionalism

12 hours

Students will develop personal and professional skills in the classroom that will transfer to the workplace.

- Time management and organization
- Creative thinking and problem solving
- Teamwork
- Interpersonal skills
- Job search skills including: resume, job applications and effective interview skills
- Uniform expectations
- Work with a variety of technology
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- Punctuality

Standards Alignments:

CCSS: RLST 11-12.3, 11-12.5; WS 11-12.7

NGSS: SEP 4, 8

Key Assignments	CTE Anchor Standards	CTE Pathway Standards
<p>✓ Key Assignment: Student will participate in mock interviews with industry professionals, peers and instructors to increase their communication, interpersonal and employability skill-set.</p> <p>Assessment: rubric, observation of role playing, peer and self- assessment</p>	2.1, 2.2, 2.3, 2.4, 2.5 3.1, 7.7	
<p>✓ Key Assignment: Students will prepare a portfolio including a cover letter and resume through workshop, self and peer editing, teacher instruction and demonstration.</p> <p>Assessment: rubric, observation, peer and self- assessment</p>	2.4 ,11.5	
<p>✓ Key Assignment: Students will create and organize a classroom binder, video and interactive notebook to take with them upon graduation for future reference.</p> <p>Assessment: rubric, grading form sheet, interactive notebook, student documentation, video</p>	2.4, 2.5, 2.6, 11.2, 11.5	D 3.3, D 3.4, D 3.7 D 11.2, D 11.3, D 11.4, D 11.5, D 11.6, D 11.7, D 11.9, D 11.10, D 11.11, D 11.12,
<p>✓ Key Assignment: Students will have the opportunity to participate in a SkillsUSA Competition. In preparation for competition, students will fund raise, attend meetings, meet all requirements and deadlines while preparing for the competition.</p> <p>Assessment: observation, teacher-student conference, written work samples, NEC checklist</p>	1.0, 2.1, 2.2, 2.3, 2.4, 2.5, 3.0, 4.1, 5.0, 7.7, 9.0, 10.0, 11.5	D 2.8, D 3.1, D 3.3, D 3.4, D 3.5, D 3.7, D 11.2, D 11.4, D 11.5, D 11.6, D 11.7, D 11.9, D 11.10, D 11.11, D 11.12

Ongoing Unit: Safety and Environmental Inspection

22 hours

Students will learn how to identify safety hazards, proper tool use in the lab and learn how to maintain a safe work environment according to NEC Codebook and local regulations.

- Environmental laws
- Introduction to tools safety
- MSDS (materials safety data sheet)
- Proper waste disposal and recycling
- Electrical safety
- Proper PPE (Personal Protective Equipment)

Standards Alignments:

CCSS: RLST 11-12.3, 11-12.4, 11-12.10; WS 11-12.7; A-CED 4

NGSS: SEP 4

Key Assignments	CTE Anchor Standards	CTE Pathway Standards
<p>✓ Key Assignment: Using a checklist aligned with NEC standards provided by instructor, students will role play an electrical inspector and explore the lab looking for safety violations in electrical installation and suggest improvement with corrective action in written form.</p> <p>Assessment: teacher observation, sign-off sheet</p>	6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 7.7	D 1.2
<p>✓ Key Assignment: Students will participate in a lock out tag out activity in lab which consists of a series of, videos and reading material related to safety in the electrical field. After successful completion and demonstration of a lock out tag out scenario, students will receive a certificate of acknowledgment for their achievement.</p> <p>Assessment: demonstration, teacher feedback</p>	2.1, 6.10, 7.7, 10.1, 10.2, 10.5, 11.1, 11.2	D 2.3, D 11.1
<p>✓ Key Assignment: Using teacher provided handout for reference, students will troubleshoot faulty lighting fixture to determine cause of problem and take appropriate steps to replace which will include proper ladder and tool use, lock out tag out routine and determination of proper replacement parts. Students will demonstrate competency to instructor.</p> <p>Assessment: demonstration, teacher feedback, discussion</p>	2.1, 4.1, 5.0, 6.4, 6.6, 7.7, 9.7, 10.1, 10.2, 10.5, 11.1	D 11.1, D 11.7, D 11.9 D 11.10
<p>✓ Key Assignment: Following a teacher demonstration and teacher supervision, students will replace an electrical device demonstrating proper safety steps while working on live power which will include: proper PPE (personal protective equipment), one hand rule and the proper use of ladder and hand tools.</p> <p>Assessment: demonstration, teacher feedback, quiz</p>	2.1, 4.1, 5.0, 6.4, 6.6, 7.7, 9.7, 10.1, 10.2, 10.5, 11.1	D 2.3, D 3.1, D 11.1 D 11.4, D 11.7, D 11.9 D 11.10, D 11.11

Ongoing Unit: National Electrical Code

80 hours

Throughout the school year, students will learn and apply electrical terminology and NEC code daily to all projects.

- NEC Codebook
- Electrical terminology
- Chart and table reading

Standards Alignments:

CCSS: RSIT 11-12.2; RSLT 11-12.2, 11-12.3, 11-12.4, 11-12.9; AD 12.3

NGSS: SEP 3, 4, 8; ETS 1.B

Key Assignments	CTE Anchor Standards	CTE Pathway Standards
<p>✓ Key Assignment: Students will role play as an electrical inspector and will use their NEC knowledge to find violations in electrical installation and suggest improvement with corrective action in written form.</p> <p>Assessment: teacher observation, sign-off sheet</p>	6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 7.7	D 1.2
<p>✓ Key Assignment: Students will be provided an incomplete residential blueprint consisting of room designations to determine lighting load and small appliance circuits. They will generate a completed blueprint including receptacle spacing, light switches, GFIs, AC-DC smoke detectors, and conductor and breaker sizing for electrical devices per NEC code. Students will use the completed blueprint as a guide for hands on activity.</p> <p>Assessment: written documentation, observation, blueprint completion, correct math calculations</p>	4.1, 5.1, 5.2, 5.4, 6.7, 9.7, 10.1, 10.2, 10.3, 10.7, 11.1	D 2.1, D 2.3, D 2.9, D 3.1, D 3.2, D 3.3, D 3.4, D 3.5, D 3.6
<p>✓ Key Assignment: Students will complete a daily timesheet which includes a list of projects completed for the day, parts used, “NEC Code of the Day” and an industry standard vocabulary word. Students will use the timesheet as a study guide for weekly tests.</p> <p>Assessment: teacher observation, collaboration, time sheet check off, stamping, quiz, test</p>	6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 7.7	D 1.2

Unit 1: Basic Electrical Circuits and Meters

80 hours

Students will read values using digital meters, learn functions and electrical characteristics and requirements of a basic circuit.

- Voltage
- Amps
- Resistance
- Watts
- Ohm's Law Theory
- Electrical components

Standards Alignments:

CCSS: RLST 11-12.3, 11-12.4, 11-12.9; A-CED 4

NGSS: SEP 3, 4, 5, 8; ETS 1.B

Key Assignments	CTE Anchor Standards	CTE Pathway Standards
<p>✓ Key Assignment: Using a color code chart, students will identify the value of a resistor and will use a multimeter to read the resistance to compare findings between the color chart and multimeter reading to determine the accuracy.</p> <p>Assessment: quiz, multimeter use demonstration, competency checklist</p>	5.1, 5.2, 5.4, 6.2, 6.4 6.12, 10.1, 10.2, 10.5	D 11.3
<p>✓ Key Assignment: Using Ohm's Law Theory and a multimeter, students will solve for and identify the unknown value of voltage, amps or watts by demonstrating and documenting the proper steps to solve the problem. Students will use the multimeter to verify their math competency. (Students will use this skill throughout the year in various scenarios).</p> <p>Assessment: quiz, live demonstration, math check</p>	5.0, 6.2, 6.4, 6.12, 9.7, 10.1, 10.5,	D 2.8, D 11.3
<p>✓ Key Assignment: Students will identify a wide variety of different electrical components/devices and describe their function within the basic electrical circuit.</p> <p>Assessment: quiz, live demonstration, observation and collaboration with peers and instructor</p>	2.1, 2.4, 5.1, 5.2, 5.3 9.7, 10.1	D 3.1, D 3.2, D 3.3, D 3.4, D 11.3, D 11.11

Unit 2: AC-DC Theory **40 hours**

Students will recognize the difference between alternating current and direct current while troubleshooting and installing electrical circuits.

- Alternating current
- Direct current
- Electromagnetism
- Electron flow
- Electrical circuit

Standards Alignments:
CCSS: RSIT 11-12.2; RLST 11-12.2, 11-12.3, 11-12.4, 11-12.9; **WS** 11-12.7; **WHSST** 11-12.7; **A-CED** 4
NGSS: SEP 4, 5, 8; ETS 1.B

Key Assignments	CTE Anchor Standards	CTE Pathway Standards
<p>✓ Key Assignment: Students will identify and explain the difference between alternating and direct current. Once AC or DC is determined, they will use the proper setting on the multimeter to test the voltage of the circuits.</p> <p>Assessment: quiz, student demonstration</p>	2.1, 5.1, 5.2, 6.2, 6.10, 10.1, 10.5	D 3.1
<p>✓ Key Assignment: Working in groups, students will build upon prior knowledge and research electromagnetism and electron flow and build their own magnets with a variety of strengths and demonstrate their magnet’s strength by picking up small objects around the lab. Peers and instructor will ask questions and offer suggestions.</p> <p>Assessment: quiz, demonstration, peer and instructor feedback</p>	2.1, 4.1, 5.1, 6.4, 6.6, 6.10, 7.7, 9.7, 10.3, 10.5, 11.1	D 11.3

Unit 3: Symbols, Schematics and Blueprints **70 hours**

Students will learn to read and create variety of blueprints and schematics including proper industry standard symbols.

- Schematics
- Blueprints
- Electrical symbols

Standards Alignments:
CCSS: RLST 11-12.3, 11-12.4; **A-CED** 4
NGSS: SEP 1, 2, 3, 4, 5; **CC** 3, 6

Key Assignments	CTE Anchor Standards	CTE Pathway Standards

<p>✓ Key Assignment: Students will work in teams of two to accurately measure the electrical lab classroom, including: floor space dimensions windows, doors, furniture, lighting fixtures, sinks, switches, outlets, smoke detectors using a tape measure/ruler and draw their own blueprint to scale (¼" to 1 foot) using industry standard symbols to identify all electrical components and their function. Students will display their blueprints for class critique and class will hold vote on most effective presentation.</p> <p>Assessment: gallery walk, critique</p>	<p>2.1, 4.4, 5.1, 5.3, 5.4, 6.10, 7.7, 9.7, 10.1, 10.3, 11.1</p>	<p>D 2.1, D 3.2, D 3.3, D 3.4, D 3.5, D 11.3</p>
<p>✓ Key Assignment: Given a blueprint with industry standard symbols, students will draw and label an electrical schematic identifying the power, switch leg, negative and grounding connectors to identify proper electrical flow of a circuit. Students will then use their schematic drawing to install an electrical system which may be a switch to light, a 3 way switch, GFCI, or receptacle. Upon completion, teams will demonstrate working circuit to instructor.</p> <p>Assessment: gallery walk, critique, student instructor conference, quiz, individual hands-on test</p>	<p>2.1, 4.1, 4.4, 5.1, 5.2, 5.3, 6.2, 6.4, 6.6, 6.10, 6.12, 7.7, 10.1, 10.3</p>	<p>D 2.3, D 2.9, D 3.1, D 3.2, D 3.3, D 3.4, D 3.7, D11.2, D11.3, D 11.4, D 11.5, D 11.6, D 11.7, D 11.9, D 11.10, D 11.11, D 11.12</p>

Unit 4: Transformers	20 hours
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Students will learn the basic principles and operation of multiple types of transformers.

- Types of transformers (step-up, step-down)
- Turn ratio and effects

Standards Alignments:
CCSS: RLST 11-12.3, 11-12.4, 11-12.7, 11-12.9; **WS** 11-12.7; **WHSST** 11-12.7; **A-CED** 4
NGSS: SEP 1, 3, 4, 5, 8; **ETS** 1.A

Key Assignments	CTE Anchor Standards	CTE Pathway Standards
<p>✓ Key Assignment: In collaborative teams, students will draw and label a schematic of a residential doorbell, choose proper materials to complete the job and properly install a functional doorbell to industry standards.</p> <p>Assessment: observation, completed schematic, quiz</p>	<p>2.1, 4.1, 5.1, 6.4, 6.6, 6.10, 6.12, 7.7, 9.7, 10.3, 10.5, 11.1,</p>	<p>D 2.3, D3.1, D 3.2, D 3.3, D 3.4, D 3.7, D 11.2, D 11.3, D 11.4, D 11.5, D 11.6, D 11.7, D 11.9, D 11.10, D 11.11, D 11.12</p>

<p>✓ Key Assignment: Using NEC codebook, students will measure, draw and label a schematic of all PG&E and SVCTE transformers on campus, identify different size transformers and calculate conduit and conductor size needed to safely operate transformers.</p> <p>Assessment: quiz, completed schematic, observation</p>	<p>2.1, 4.1, 5.1, 5.3, 5.4, 9.7, 10.1, 10.2, 11.1</p>	<p>D 2.3, D 2.9, D 3.1, D 3.2, D 3.3, D 3.4, D 3.5, D 11.3</p>
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Unit 5: Motor Control	40 hours
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Students will learn the basic theory of motor control and how it is used in the electrical industry.

- Motor control schematics and symbols
- Motor control theory
- Relay and motor starters

Standards Alignments:
CCSS: RSLT 11-12.2, 11-12.3, 11-12.4; **WS** 11-12.7; **WHSST** 11-12.7; **A-CED** 4
NGSS: SEP 1, 4, 5; PS 1.A, 4.C; CC 2, 6

Key Assignments	CTE Anchor Standards	CTE Pathway Standards
<p>✓ Key Assignment: Using a motor control interactive computerized simulator, student in teams of two will complete up to ten modules with the interactive simulator including: written and hands-on assessments regarding basic safety, three phase power, symbols, motor wiring, troubleshooting to 80% or better accuracy. When completed with simulation, students wire electrical components on a live three phase motor control circuit and demonstrate/explain proper operational procedures to the instructor.</p> <p>Assessment: observation, quiz, written work, student conference, rubric, computerized feedback</p>	<p>2.1, 2.2, 4.1, 5.1, 5.3, 6.4, 6.12, 7.7, 10.1, 10.2, 10.5, 11.1</p>	<p>D 2.3, D 2.8, D 3.1, D 3.2, D 3.3, D 3.4, D 11.2, D 11.3, D 11.4, D 11.5, D 11.6, D 11.7, D 11.9, D 11.10, D 11.11, D 11.12</p>

Unit 6: Commercial and Residential Wiring	140 hours
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Students will learn how to install electrical systems in residential and commercial setting using current building codes.

<ul style="list-style-type: none"> ● Conductor sizing ● Symbol recognition ● Electrical devices ● Load calculation 	<ul style="list-style-type: none"> ● Conduit bending ● Residential codes ● Commercial codes 	<ul style="list-style-type: none"> ● Wire pulling techniques ● Troubleshooting ● Electrical panels ● Blueprint reading
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Standards Alignments:

CCSS: LS 11-12.6; **RSIT** 11-12.2; **RLST** 11-12.2, 11-12.10; **WS** 11-12.7; **WHSST** 11-12.7, 11-12.9; **A-CED** 4; **G-SRT** 8.1

NGSS: SEP 1, 3, 4, 5, 7, 8; **ETS** 1B, 1C; **CC** 2, 6

Key Assignments	CTE Anchor Standards	CTE Pathway Standards
<p>✓ Key Assignment: Following a blueprint provided by instructor, students will work in pairs to wire an electrical system of a residential bedroom which may include switches, lights and receptacles following all NEC codes. Once verified as working, team A will switch with team B and sabotage each other's electrical system. Teams will se troubleshooting techniques to employ critical thinking and collaboration to diagnose and repair the electrical system to good working order.</p> <p>Assessment: multiple quizzes, observation, peer feedback, visual inspection</p>	<p>2.1, 5.0, 6.2, 6.6, 6.7, 6.10, 6.12, 7.7, 9.7, 10.1, 10.2, 10.3, 10.5, 11.1</p>	<p>D 2.3, D 3.1, D 3.2, D 3.3, D 3.4, D 3.7, D 11.2, D 11.3, D 11.4, D 11.5, D 11.6, D 11.7, D 11.9, D 11.10, D 11.11, D 11.12</p>
<p>✓ Key Assignment: Students will be provided an incomplete residential blueprint consisting of square footage, room designations and appliance list to determine the size of the main electrical panel needed for given home. They will use a math formula along with the square footage of home to determine lighting load circuits, appliance load and small appliance load. They will generate a completed blueprint including receptacle spacing, light switches, GFIs, AC-DC smoke detectors and conductor & breaker sizing for electrical devices per NEC code.</p> <p>Assessment: written documentation, observation, blueprint completion, correct math calculations</p>	<p>4.1, 5.1, 5.2, 5.4, 6.7, 6.10, 7.7, 9.7, 10.1, 10.2, 10.3, 11.1</p>	<p>D 2.1, D 2.3, D 2.9, D 3.1, D 3.2, D 3.3, D 3.4, D 3.5, D 3.6</p>
<p>✓ Key Assignment: Students will be given a wiring scenario for a commercial electrical system. They will determine the proper type and size of conduit to use as the raceway and use a conduit bender and mathematical formulas to bend conduit into a variety of angles and configurations using multiple pulling techniques to satisfy requirements for raceway per NEC code.</p> <p>Assessment: written assessments, observation and demonstration and oral defense</p>	<p>2.1, 4.1, 5.1, 5.2, 5.4, 6.7, 6.10, 6.12, 7.5, 9.7, 10.1, 10.2, 10.3, 10.5, 11.1</p>	<p>D 2.3, D 11.2, D 11.3, D 11.4, D 11.6, D 11.7, D 11.9</p>

Unit 7: Alternative Energy **15 hours**

Students will explore alternative energy sources and their function within the electrical field

- Solar
- Wind
- Water

Standards Alignments:
CCSS: RSIT 11-12.7; RLST 11-12.3, 11-12.4, 11-12.7, 11-12.9; **WS** 11-12.7 ; **WHSST** 11-12.7 , 11-12.9
NGSS: SEP 1, 3, 4, 7, 8; PS 2A, 3A; ETS 1.B, 2.A; CC 5

Key Assignments	CTE Anchor Standards	CTE Pathway Standards
<p>✓ Key Assignment: Students will research various alternative energy sources and consider the pros/cons and local environmental impact of their topic of choice. They will summarize their findings in written or pictorial format and defend their choices.</p> <p>Assessment: observation, discussion, peer collaboration</p>	2.4, 2.5, 4.1, 4.3, 4.5, 5.1, 5.4, 7.1, 8.2, 9.7, 10.1	D 1.2, D 1.3, D 9.2, D 9.4, D 9.5, D 9.6
<p>✓ Students will have a chance to collaborate with a variety of Industry workers, guest speakers and field trips to explore how electricians are used within the water industry and other positions available within the water industry. They will be encouraged to ask questions and participate in classroom discussion.</p> <p>Assessment: discussion, teacher observation</p>	3.4, 3.5	D 1.2

Instructional Materials

Textbooks:	Electronic Media/Supplemental Print Materials/Online Resources:
<p>NEC 2011 International Electrical Code – National Fire Agency 70 © 2010 ISBN: 978-0-8776-5914-3</p> <p>Electrical Wiring Residential 17th edition Mullin & Simmons - Delmar Cengage Learning – © 2012 ISBN: 978-1-4354-9826-6</p> <p>Standard Textbook of Electricity 5th edition Stephen L Herman – Delmar Cengage Learning – © 2011 ISBN: 978-1-111-53915-3</p> <p>Blueprint Reading for Electricians 3rd edition National Joint Apprenticeship training – Delmar Cengage Learning – © 2010 ISBN: 978-1-4354-9119-9</p>	<ul style="list-style-type: none"> ● Go-Pro (or similar product) ● Tablet ● On-line Residential Wiring Interactive Program ● On-line Motor Control Interactive Program ● AC/DC Theory Computer Program ● Electrical Circuits Computer Program

Standards Assessed in this Course

CTE Anchor Standards

- 1.0 Academics: Academics standards are aligned to pathways; see below.
- 2.0 Communications: Acquire and use accurately 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 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 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 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 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.
- 10.0 Technical Knowledge and Skills: Apply essential technical knowledge and skills common to all pathways in the sector following procedures when carrying out experiments or performing technical tasks.

Industry Sector: Building and Construction Trades - Industry Pathway: Residential and Commercial Construction

D 1.0 Recognize the impact of financial, technical, environmental, and labor trends on the past and future of the construction industry.

- D 1.1 Understand significant historical trends in the construction industry.
- D 1.2 Understand the environmental regulations that influence residential and commercial design.
- D 1.3 Demonstrate knowledge of the California Environmental Quality Act (CEQA) and Environmental Impact Review (EIRs) impacts on residential and commercial construction.

D 2.0 Apply the appropriate mathematical calculations used in the construction trades.

- D 2.1 Apply formulas to determine area, volume, lineal, board, and square feet.
- D 2.2 Apply the Pythagorean Theorem to calculate pipe offsets, roof slope, and check for square.
- D 2.3 Estimate the materials needed to complete a specific task.
- D 2.4 Determine the total developed length of the water supply piping system.
- D 2.5 Calculate the residual pressure at the highest outlet per the requirements of the Plumbing Code.
- D 2.6 Calculate the total fixture unit demand from the fixtures indicated on the construction drawings using the tables of the plumbing code.
- D 2.7 Calculate the proper slope for drain, waste and vent (DWV) piping.
- D 2.8 Apply Ohm's Law to calculate resistance, current flow, and voltage in series, parallel, and combination circuits.
- D 2.9 Calculate the load on an electrical system from general lighting and small and large appliances.

D 3.0 Interpret and apply information from technical drawings, schedules, and specifications used in the construction trades.

- D 3.1 Identify the elements used in technical drawings, including types of lines, symbols, details, and views.
- D 3.2 Identify and interpret the elements of technical drawings, including plan, elevation, section, and detail views.
- D 3.3 Interpret technical drawings specifications.
- D 3.4 Identify plumbing, electrical, and mechanical symbols and other abbreviations used in construction drawings.
- D 3.5 Interpret and scale dimensions from a set of plans using an architect's scale.
- D 3.6 Interpret sectional and detail drawings to determine construction details such as corners, rough openings, stairs, and roof systems.
- D 3.7 Understand the sequencing and phases of residential and commercial construction projects.

D 4.0 Demonstrate techniques for proper site preparation.

- D 4.1 Use leveling devices to check for elevation, level, and plumb.
- D 4.2 Demonstrate how to establish grades using survey instruments.
- D 4.3 Install batter boards.
- D 4.4 Check site layout for square using the diagonal method.
- D 4.5 Describe excavation and backfill methods.
- D 4.6 Identify different methods and equipment used for compaction.
- D 4.7 Identify types of backfill materials and how they are used.

D 5.0 Demonstrate foundation layout techniques to include setting forms, placing reinforcements, and placing concrete according to construction drawings, specifications, and building codes.

- D 5.1 Describe the sequencing procedures for placing large and small slabs.
- D 5.2 Demonstrate how to establish elevations for concrete structures.
- D 5.3 Lay out location and elevation of concrete/masonry structures based on construction drawings.
- D 5.4 Develop a material take-off in accordance with construction drawings and specifications.
- D 5.5 Lay out location for reinforcements, expansion joints, openings, and embedded items based on construction drawings, specifications, and building codes.
- D 5.6 Construct, place, and brace forms for concrete as detailed in construction drawings for footings, slab, and raised floors.
- D5.7 Place and secure reinforcement as detailed by construction drawings, building codes, and industry standards.
- D5.8 Place secure embedded hardware as detailed on construction drawings.
- D5.9 Demonstrate proper removal and care of concrete forms.
- D5.10 Use appropriate tools and techniques for placing, compacting, screeding, and finishing consolidating concrete in slabs and footings.

D6.0 Demonstrate carpentry techniques for the construction of a single-family residence.

- D6.1 Properly place a moisture barrier and pest control guard on a foundation.
- D6.2 Attach a sill plate at top of concrete foundation.
- D6.3 Lay out, cut, and install joist supports, rim joists, and floor joists as specified on construction plans.
- D6.4 Install a subfloor.
- D6.5 Demonstrate wall and plate layout, including rough openings.
- D6.6 Measure, cut, and assemble wall components using appropriate tools and fasteners.
- D6.7 Demonstrate the ability to square wall systems and install wall bracing and shear panels according to code.
- D6.8 Stand, square, plumb, and brace walls.
- D6.9 Describe the applications and uses of metal stud framing.
- D6.10 Lay out, cut, and install ceiling joists and common and jack rafters.
- D6.11 Frame and erect shed and gable roof systems.
- D6.12 Lay out and install trusses “on-center” with specified hardware.

D6.13 Install appropriate blocking, bracing, lookouts, fascia, and drip edge.

D6.14 Frame for roof penetrations and attic access.

D6.15 Apply roof sheathing and install appropriate flashings.

D6.16 Understand different roofing materials and methods of application.

D7.0 Demonstrate proper installation techniques of interior finish materials and protective finishes.

D7.1 Identify types and uses of wall finishing materials.

D7.2 Cut, fit, and install gypsum wallboard onto a framed wall using appropriate fasteners.

D7.3 Describe the finishes and textures for gypsum wallboard.

D7.4 Properly prepare walls to receive protective finishes.

D7.5 Apply finishes according to specifications and industry standards.

D7.6 Identify types and application of finish flooring materials.

D7.7 Install pre-hung interior doors.

D7.8 Install interior trim and casework.

D8.0 Demonstrate the application of exterior finish materials and protective finishes in building construction.

D8.1 Describe the installation procedures and techniques of masonry siding materials.

D8.3 Install wood, vinyl, and/or manufactured siding.

D8.4 Demonstrate preparation techniques for applying exterior paint and stain.

D8.5 Apply exterior paint and stain according to specifications.

D8.6 Describe various types and uses of doors and windows used in building construction.

D8.7 Install pre-hung windows and doors using appropriate flashing and trim.

D8.8 Caulk and seal joints to prevent air and moisture infiltration and increase energy efficiency.

D8.9 Install vents for efficient attic and crawl space ventilation.

D8.10 Install various types of floor, wall, and ceiling thermal insulation.

D8.11 Describe mold-prevention techniques.

D9.0 Understand, integrate, and employ sustainable construction practices in the building trades.

D9.1 Identify design and energy solutions for improving building energy efficiency.

D9.2 Identify materials used in building construction to increase energy efficiency and sustainability.

D9.3 Calculate energy requirements and loads for buildings and structures.

D9.4 Demonstrate the application of constructing materials intended to improve building efficiency and sustainability.

D9.5 Analyze and evaluate buildings for energy efficiency and performance.

D9.6 Develop solutions to improve building energy performance and efficiency.

D10.0 Demonstrate skills necessary to complete a plumbing system in a single-family residence in accordance with accepted industry standards.

D10.1 Demonstrate techniques for cutting, deburring, and joining metallic and nonmetallic water piping.

- D10.2 Lay out and install hot and cold water piping to fixture locations as indicated on the construction documents.
- D10.3 Perform pressure test of an installed piping system.
- D10.4 Install fastened in-place fixture valves and shut-off valves as indicated on construction drawings.
- D10.5 Install and secure proper drainage piping to fixture locations.
- D10.6 Determine the proper slope for DWV piping using hand levels, laser levels, and transits.
- D10.7 Install traps and vents as indicated by construction drawings, specifications, and government codes.
- D10.8 Install angle stops at water supply stub outs.
- D10.9 Install plumbing fixtures.
- D10.10 Connect the water supply to faucets and water closets.
- D10.11 Connect fixture tailpieces to fixtures and to traps.
- D10.12 Check for the proper functioning of fixtures.

D11.0 Demonstrate skills necessary to complete an electrical system in a single-family residence in accordance with accepted industry standards.

- D11.1 Determine whether or not an electrical circuit is “live.”
- D11.2 Prepare rough framing for the installation of electrical cables and conduit.
- D11.3 Lay out components to the tolerances indicated on the construction drawings, specifications, and government codes.
- D11.4 Install typical devices, junction boxes, and panels.
- D11.5 Install lighting and ceiling fan support boxes according to the National Electrical Code (NEC).
- D11.6 Install conduit typical of residential construction and pull conductors through conduit as required by the NEC.
- D11.7 Splice and tap conductors for the installation of fixtures and devices.
- D11.8 Install low voltage control and communication cables.
- D11.9 Demonstrate grounding techniques for all electrical boxes, cabinets, and enclosures.
- D11.10 Terminate electrical connections to receptacles, switches, lighting fixtures, large appliances, and other devices.
- D11.11 Select receptacles and switches based on load requirements.
- D11.12 Terminate equipment grounding and neutral conductor at the electrical service.
- D11.13 Terminate communication and control wiring.

Common Core State Standards

Language Standards – LS (Standard Area, Grade Level, Standard #)

- LS 11-12.6. Acquire and accurately use general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career B1.0, B2.0, C1.0, C2.0, A1.0, A2.0 D7.0, D8.0 readiness level; demonstrate independence in gathering vocabulary knowledge when B3.0, B4.0 C3.0, C4.0 considering a word or phrase important to comprehension or expression.

Reading Standards for Informational Text – RSIT (Standard Area, Grade Level, Standard #)

- RSIT 11-12.2. Determine two or more central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to provide a complex analysis; provide an objective summary of the text.
- RSIT 11-12.7. Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

Reading Standards for Literacy in Science and Technical Subjects – RLST (Standard Area, Grade Level, Standard #)

- RLST 11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text
- RLST 11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.
- RLST 11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
- RLST 11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
- RLST 11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
- RLST 11-12.10. By the end of grade 12, read and comprehend science/technical texts in the grades 11-12 text complexity band independently and proficiently.

Writing Standards – WS – (Standard Area, Grade Level, Standard #)

- WS 11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects – WHSST – (Standard Area, Grade Level, Standard #)

- WHSST 11-12.7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- WHSST 11-12.9. Draw evidence from informational texts to support analysis, reflection, and research.

Math Standards – Algebra – Creating Equations – A-CED – (Standard Area, Grade Level, Standard #)

- A-CED 4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in C3.0, C4.0, B2.0, B8.0 D2.0 solving equations. For example, rearrange Ohm’s law $V = IR$ to highlight resistance R .

Math Standards – Geometry – Similarity, Right Triangles, and Trigonometry – G-SRT – (Standard Area, Grade Level, Standard #)

- G-SRT 8.1 Know and use angle and side relationships in problems with special right triangles, such as, 30°, 60°, and 90° triangles and 45°, 45°, and 90° triangles.

California History/Social Science Standards

AD 12.3 Students evaluate and take and defend positions on what the fundamental values and principles of civil society are (i.e., the autonomous sphere of voluntary personal, social, and economic relations that are not part of government), their Interdependence, and the meaning and importance of those values and principles for a free society.

Next Generation Science Standards

Scientific and Engineering Practices

- SEP 1 Asking questions (for science) and defining problems (for engineering)
- SEP 2 Developing and using models
- SEP 3 Planning and carrying out investigations
- SEP 4 Analyzing and interpreting data
- SEP 5 Using mathematics and computational thinking
- SEP 6 Constructing explanations (for science) and designing solutions (for engineering)
- SEP 7 Engaging in argument from evidence
- SEP 8 Obtaining, evaluating, and communicating information

Disciplinary Core Ideas

- PS 1.A Structure and Properties of Matter
- PS 2.A Force and Motion
- PS 3.A Definitions of Energy
- PS 4.C Information Technologies and Instrumentation
- ETS 1.A Defining and Delimiting an Engineering Problem
- ETS 1.B Developing POSSible Solutions
- ETS 1.C Optimizing the Design Solution
- ETS 2.A Interdependence of Science, Engineering, and Technology

Crosscutting Concepts

- CC 2. Cause and effect: Mechanism and explanation
- CC 3. Scale, proportion, and quantity
- CC 5. Energy and matter: Flows, cycles, and conservation
- CC 6. Structure and function