LAUSD UNIFIED Division of Adult and Career Education

Career Technical Education (CTE) Course Outline

Course Title:	Electrical Theory & Motor Controls Fundamentals
Course Number:	72-75-45
Date:	July 2025
Industry Sector:	Energy, Environment & Utilities
Pathway:	Energy & Power Technology
CBEDS Title:	Introduction to Electrical Power Systems
CBEDS Code:	5583
CalPADS	7620
Credits:	10

Hours:

Total
120

Course Description:

This competency-based course is designed to familiarize the student with electrical theory and motor control fundamentals. This curriculum was designed specifically for the International Longshore and Warehouse Union (ILWU) and the Pacific Maritime Association (PMA). Technical instruction includes an introduction, safety, mathematics, electrical concepts, uses and dangers of electricity, Ohm's and Watt's Law, electrical circuit types, alternating current, motors, generators, relays and transformers, protective devices, wire resistance, voltage drop, multiwire circuits, formula wheel, motor controls introduction, motor controls and schematics, reversing controls, controls for multiple motors, motor control station, motor windings, motors, motor circuits, and controllers, employability skills, and resume preparation. The competencies in this course are aligned with the California Common Core Standards and the California Career Technical Education Model Curriculum Standards.

Prerequisites:	Enrollment requires a 6.0 reading level and 8.0 math level as measured by the CASAS GOALS test.
NOTE:	For Perkins purposes this course has been designated as an **introductory** course.

	This course **cannot** be repeated once a student receives a Certificate of Completion.
A-G Approval	N/A
Methods of Instruction:	Lecture and discussion, demonstration and participation, multimedia presentations, individualized instruction, peer teaching, role-playing, guest speakers, field trips and field study experiences, projects.
Student Evaluation:	Summative: End of section assessments
Industry Certification:	none
Recommended Texts:	Holt, Mike. Understanding Electrical Theory, Mike Holt Enterprises of Leesburg Inc. 2022 Holt, Mike. Understanding Basic Motor Controls, Mike Holt Enterprises Leesburg Inc. 2022
Link to Resource Folder	https://bit.ly/electricalcontrolsresources

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
A. INTRODUCTION Understand, apply, and evaluate classroom and workplace policies and procedures. (1 hour)	1. Describe the scope and purpose of the course. 2. Discuss relevance of the Variable Frequency Drive (VFD) and Programmable Logic Control (PLC) pertaining to this course. 3. Discuss and demonstrate Zoom, Schoology, and basic computer skills. 4. Identify classroom policies and procedures, expectations, and goals. 5. Discuss, identify, research, and draw conclusions about different career paths, occupations, employment outlook, and career advancements in the Energy, Environment, & Utilities Industry Sector which impact electricians. 6. Describe opportunities available for promoting gender equity and the representation of non-traditional populations. 7. Explain and recognize the importance of customer-oriented service, ethics, teamwork, respect for individual and cultural differences, and diversity in the workplace.	**Career Ready Practice:** 1, 2, 3, 4, 5, 8, 9, 10, 11 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Career Planning & Management: 3.1, 3.2, 3.3, 3.4, 3.5, 3.9 Technology: 4.2, 4.5 Problem Solving & Critical Thinking: 5.4 Ethics & Legal Responsibilities: 8.4 Leadership & Teamwork: 9.3, 9.6 Demonstration & Application: 11.1 **CTE Pathway:** B6.3
B. SAFETY	1. Discuss classroom and workplace first aid, emergency procedures, accidents, and injury prevention. 2. Discuss the California Occupational Safety and Health Administration (Cal/OSHA) workplace requirements for	**Career Ready Practice:** 1, 2, 4, 5, 10, 11, 12

Understand safety procedures and techniques. (6 hours)	electricians to maintain a safe and healthy working environment. 3. Discuss and research the use of the Safety Data Sheet (SDS) as it applies to the Energy, Environment, & Utilities Industry Sector. 4. Practice personal safety when lifting, bending, or moving equipment and supplies. 5. Explain how each of the following ensures a safe workplace: a. employees' rights as they apply to job safety b. employers' obligations as they apply to safety c. safety laws applying to electrical tools 6. Explain and demonstrate proper use of tools, safety rules, regulations, and shop procedures. 7. Describe and demonstrate standards regarding the following proper use of protective equipment: a. safety glasses or goggles b. hard hats c. safety shoes/boots d. insulating gloves e. flame-resistant clothing f. hearing protection g. harnesses and lanyards to prevent falls from heights 8. Explain the dangers and usage of electricity to include: a. purpose of the National Electrical Code (NEC) b. how electrical fires are created c. definitions of electric shock/electrocution d. definitions of arch flashes and arc blast 9. Pass the Safety Test with 100% accuracy.	**CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.1, 4.2, 4.5 Problem solving & Critical Thinking: 5.4 Health & Safety: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 6.10, 6.11, 6.12, 6.13, 6.14, 6.15, 6.16 Technical Knowledge & Skills: 10.1, 10.2 Demonstration & Application: 11.1 **CTE Pathway:** B4.5
C. MATHEMATICS Understand, apply, and evaluate the basic mathematical and trigonometry function to determine three-phase voltage systems and alternating-current wire impedance.	1. Describe and explain the following terms: a. addition b. subtraction c. multiplication d. division e. whole numbers f. fractions g. percentages 2. Explain and demonstrate how to convert a percentage into decimal to use as a multiplier. 3. Explain the difference between a reciprocal, a square root, and the squaring of a number. 4. Define, describe, and explain the: a. triangle b. Pythagorean Theorem in relation to power formula c. metric system and its trade applications	**Career Ready Practice:** 1, 2, 4, 5, 9, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2, 4.3 Problem Solving & Critical Thinking: 5.1, 5.2, 5.3, 5.4

(6 hours)	5. Work in teams to solve math equations by interpreting information and drawing conclusions to make informed decisions. 6. Pass a Mathematics assessment with an 80% score or higher.	Leadership & Teamwork: 9.7 Technical Knowledge & Skills: 10.1 Demonstration & Application: 11.1 **CTE Pathway:** B1.4
D. ELECTRICAL CONCEPTS Understand and apply the basic structure of an atom, and the law of electrical charges and how it relates to static charge and electricity. Explain the principles behind lightning protection systems.	1. Define and explain the following terms: a. electricity b. static electricity c. Alternate Current (AC) d. Direct Current (DC) e. magnets f. magnetism g. polarity h. magnetic polarity i. magnetic metals j. nonmagnetic metals k. conductors l. insulators m. semiconductors n. electrons 2. Explain the atomic structure of an atom to include: a. the law of electrical charges b. static charge and static electricity c. lighting and how lighting protection works 3. Explain the electron theory and chemical bonding to include: a. electron orbitals b. valence electrons c. freeing valence electrons from an atom d. conductance e. insulators semiconductors f. chemical bonding 4. Explain and demonstrate the electrical circuits and power sources to include: a. the electrical circuit and its components	**Career Ready Practice:** 1, 2, 4, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2 Technical Knowledge & Skills: 10.1 Demonstration & Application: 11.1 **CTE Pathway:** B1.1, B1.3, B1.4, B2.1, B2.2, B3.1, B3.3. B3.4, B3.5, B3.6, B4.1, B4.2, B4.4, B5.1, B5.3, B6.1, B6.2

(5 hours)	b. electric current flow c. electrical power source 5. Explain and demonstrate the electrical systems to include: a. the source of electrical generation b. step-up transmission voltage c. high-voltage transmission lines d. primary distribution voltage and wires 6. Pass an Electrical Concepts assessment with an 80% score or higher.	
E. ELECTRICITY: USES & DANGERS Understand, apply, and evaluate the fundamental uses and dangers of electricity. (4 hours)	1. Define and explain the uses of electricity to include: a. electricity and its uses b. electrochemical processes c. electromagnetism d. photoelectric heating e. lighting 2. Explain and demonstrate magnetism and electromagnetism to include: a. the basics of magnetism b. the natural magnet c. magnetic polarities d. the theory of magnetism e. permanent and temporary magnets f. magnetizing and demagnetizing magnets g. magnetic lines of force h. the law of attraction and repulsion of magnet 3. Introduce and demonstrate magnetism to include: a. an electromagnetism in a wire b. an electromagnet field interaction c. an electromagnetic field interaction of wire loops d. an electromagnetic core e. the uses of electromagnetism for motor generators, relays, and transformers 4. Pass a Dangers of Electricity assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 4, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2 Technical Knowledge & Skills: 10.1 Demonstration & Application: 11.1 **CTE Pathway:** B1.1, B1.3, B1.4, B2.1, B2.2, B3.1, B3.4, B3.6, B4.1, B4.4, B4.6, B5.1, B6.1
F. OHMS LAW & WATTS LAW Understand, apply, and evaluate Ohm's Law and Watt's Law	1. Define the following terms: a. voltage b. amperage/current flow c. resistance d. power e. electrical power f. mechanical power	**Career Ready Practice:** 1, 2, 4, 5, 9, 10 **CTE Anchor:** Academics:

to solve circuit problems. (16 hours)	g. energy 2. Define, explain, and demonstrate the Ohm's law to include: a. the electrical circuit b. electromotive force (pressure) c. circuit resistance d. circuit intensity e. the Ohm's Law formula 3. Define, explain, and demonstrate Watt's Law to include the: a. power formula circle b. power changes with the square of the voltage 4. Explain the difference between Ohm's Law and Watt's Law. 5. Work in teams to explain how the Ohm's Law and Watt's Law formula is used in DC and AC circuits. 6. Pass an Ohm's Law and Watt's Law assessment with an 80% score or higher.	1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2, 4.3 Problem Solving & Critical Thinking: 5.1, 5.2, 5.3, 5.4 Leadership & Teamwork: 9.7 Technical Knowledge & Skills: 10.1, 10.3 Demonstration & Application: 11.1 **CTE Pathway:** B5.1, B7.3, B7.4, B7.5, B7.6
G. ELECTRICAL CIRCUIT TYPES Understand, apply, and evaluate the different electrical circuit types to deliver electricity efficiently.	1. Define the following terms: a. series circuits b. parallel circuits c. combination circuits 2. Introduction to a digital multimeter and its use. 3. Define and explain the series circuit to include: a. understanding series circuits in relationship to resistance, current, and voltage b. series circuit summary c. series-connected power supplies d. demonstrating an understanding of series circuits by applying their principles and creating a diagram 4. Define and explain the parallel circuit to include: a. understanding parallel circuits in relationship to resistance, current, and voltage b. parallel circuit resistance calculations c. parallel circuit summary d. parallel-connected power supplies	**Career Ready Practice:** 1, 2, 4, 5, 9, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2 Problem Solving & Critical Thinking: 5.1, 5.2, 5.3, 5.4 Leadership & Teamwork:

(4 hours)	e. demonstrating an understanding of parallel circuits by applying their principles and creating a diagram 5. Define and explain the series-parallel circuit to include: a. understanding series-parallel circuits b. calculating resistance in series-parallel circuits c. demonstrating an understanding of combination circuits by applying their principles and creating a diagram 6. Explain the difference between series and parallel circuits. 7. Work in teams to create a series and parallel circuit to understand its uses and causes of voltage and amperage in a circuit. 8. Pass an Electrical Circuit Types assessment with an 80% score or higher.	9.7 Technical Knowledge & Skills: 10.1, 10.3 Demonstration & Application: 11.1 **CTE Pathway:** B1.4, B2.3, B5.1, B7.3, B7.4, B7.5, B7.6
H. ALTERNATING CURRENT (AC) Understand, apply, and evaluate the AC theory.	1. Define the following terms: a. Alternating Current (AC) b. Root Mean Square (RMS) c. hertz d. phase e. phase angles f. inductance g. electromagnetic force (EMF) h. reactance i. capacitance j. capacitive reactance k. impedance l. apparent power m. true power n. reactive power 2. Define, explain, and demonstrate the following alternating current fundamentals: a. alternating current production b. waveforms c. frequency d. in-phase waveforms e. out-of-phase waveforms f. alternating current waveform values 3. Define and explain inductance to include: a. how inductance works b. self-inductance c. mutual inductance d. inductive reactance e. uses of induction	**Career Ready Practice:** 1, 2, 4, 5, 9, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2 Problem Solving & Critical Thinking: 5.1, 5.3, 5.4 Leadership & Teamwork: 9.7 Technical Knowledge & Skills: 10.1, 10.3 Demonstration & Application: 11.1

(12 hours)	4. Define, explain, and demonstrate capacitance to include: a. capacitance in capacitors b. capacitor charge and discharge c. capacitive reactance d. uses of capacitors e. how cost and efficiency rates are determined for each source 5. Define and explain the fundamentals of alternating current to include: a. true power b. power losses of wires c. power losses of a terminal d. equipment efficiency e. cost of power f. power factor g. apparent power h. apparent power versus true power i. effects of power factor on circuits 6. Work in teams to demonstrate how the following can be wired in parallel and in series, and draw conclusions pertaining to: a. inductance b. capacitance 7. Work in teams to calculate power factor of a single-phase AC motor. 8. Pass an AC assessment with an 80% score or higher.	**CTE Pathway:** B1.3, B1.4, B2.2, B2.3, B2.4, B4.1, B4.2, B5.1, B6.1, B6.2, B7.3, B7.4, B7.5
I. MOTORS, GENERATORS, RELAYS & TRANSFORMERS Understand and apply the principles of motors, generators, relays, and transformers.	1. Define the following terms: a. generator b. relays c. transformer d. contactors 2. Define and explain motors to include: a. alternating-current motor principles b. motor horsepower rating c. motor amperes d. motor nameplate amperes e. dual-voltage motors f. reversal of the rotation of alternating-current motors g. alternating-current motor types h. Full Load Amps (FLA) i. Lock Rotor Amps (LRA) 3. Define and explain generators to include: a. generator prime mover	**Career Ready Practice:** 1, 2, 4, 5, 9, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2 Problem Solving & Critical Thinking: 5.1, 5.4 Leadership & Teamwork:

(8 hours)	b. alternating-current generators c. generator output current d. single-phase and three-phase generator voltages e. electrical industry voltages 4. Define and explain relays to include: a. how a relay operates b. components of a relay 5. Define and explain transformers to include: a. types of transformers b. primary versus secondary c. transformer mutual induction d. secondary induced voltage e. transformer turns ratios f. isolation transformer (1:1) g. autotransformer h. transformer Kilo Volts Ampere (kVA) rating i. transformer current flow j. transformer current rating k. transformer configurations l. Delta/wye transformers m. Delta/Delta (High-Leg) transformer 6. Define and explain contactor to include: a. how a contactor operates b. components of a contactor 7. Work in teams to demonstrate how to read the label and interpret information of a transformer to identify primary and secondary sides of the transformer, including the kVA rating. 8. Pass a Motors, Generators, Relays, & Transformers assessment with an 80% score or higher.	9.7 Technical Knowledge & Skills: 10.1, 10.3 Demonstration & Application: 11.1 **CTE Pathway:** B1.2, B1.3, B1.5, B2.1, B2.2, B2.3, B4.1, B4.2, B5.1, B5.2, B5.8, B5.9, B6.1, B6.2, B6.4, B7.3, B7.4, B7.5
J. PROTECTIVE DEVICES Understand and apply overcurrent protection, GFCIs, SPGFCIs, GFPEs, AFCIs, and SPDs.	1. Define and explain the following terms based on NECs: a. Ground-Fault Circuit Interrupters (GFCIs) b. Special-Purpose Ground-Fault Circuit Interrupters (SPGFCIs) c. Ground-Fault Protection of Equipment (GFPEs) d. Arc-Fault Circuit Interrupters (AFCIs) e. Clearing Arcing Faults f. Surge Protective Devices (SPDs) 2. Define and explain overcurrent protection based on NECs to include: a. overcurrent protection b. fuses c. circuit breakers d. overcurrent protective devices, time-current curves	**Career Ready Practice:** 1, 2, 4, 5, 9, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.1, 4.2 Problem Solving & Critical Thinking:

(4 hours)	3. Work in teams to demonstrate how to calculate and troubleshoot overcurrent devices such as fuses and circuit breakers. 4. Pass a Protective Devices assessment with an 80% score or higher.	5.1, 5.3, 5.4 Leadership & Teamwork: 9.7 Technical Knowledge & Skills: 10.1, 10.2, 10.3, 10.5, 10.6 Demonstration & Application: 11.1 **CTE Pathway:** B1.4, B4.1, B7.3, B7.4, B7.6
K. WIRE RESISTANCE, VOLTAGE DROP, MULTIWIRE CIRCUITS, & THE FORMULA WHEEL Understand and apply general knowledge of wire resistance, voltage drop, and power loss in various electrical circuits.	1. Define, explain, and demonstrate the relationship between wire resistance and voltage drop to include: a. wire sizes b. direct-current wire resistance c. NEC wire direct-current resistance d. AC wire resistance e. AC resistance vs. direct-current resistance f. wire voltage drop – Ohm's Law method 2. Work in teams to demonstrate how to calculate voltage drop for various components (wire size circuit breaker size, etc.) to make informed decisions. 3. Define and explain multiwire circuits to include: a. neutral wire b. grounded wire c. current flow on the neutral wire d. multiwire branch circuits e. dangers of multiwire circuits f. researching the NEC requirements 4. Define, explain, and demonstrate how to use the formula wheel to include: a. formula wheel quadrants b. using the formula wheel 5. Pass a Wire Resistant, Voltage Drop, Multiwire Circuits, and Formula Wheel assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 4, 5, 9, 10, 11 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.1, 4.2, 4.5 Problem Solving & Critical Thinking: 5.1, 5.2, 5.3, 5.4 Leadership & Teamwork: 9.7 Technical Knowledge & Skills: 10.1, 10.2, 10.3 Demonstration & Application:

(14 hours)		11.1 **CTE Pathway:** B1.4, B5.1, B5.2, B7.3, B7.4, B7.6
L. MOTOR CONTROLS INTRODUCTION Understand, apply, and evaluate the fundamentals of motor controls. (4 hours)	1. Define and explain the basic principles of motor controls to include: a. motor control circuits b. motor control language c. motor control basics 2. Define and explain the following: a. control terminology b. common abbreviations used for electrical terms and devices c. standard symbols relating to components 3. Define, explain, and demonstrate the following common control equipment, devices, and symbols: a. auxiliary contacts b. relays c. a drum switch d. a float switch e. a flow switch f. a limit switch-mechanical g. a limit switch-proximity h. a limit switch–optical i. a pressure switch j. a pushbutton switch k. a solenoid l. switch operations m. a temperature switch n. time relay-pneumatic o. time relay-instantaneous contacts p. time relay-solid state q. time relay-terminology r. reading a motor control schematic 4. Define and explain switches and contacts pertaining to VFD and PLC. 5. Pass a Motors Controls assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 4, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2 Technical Knowledge & Skills: 10.1 Demonstration & Application: 11.1 **CTE Pathway:** B4.1, B4.6, B5.2, B5.8, B5.9, B7.1, B7.3, B7.4
M. MOTOR CONTROLS & SCHEMATICS	1. Define, explain, and demonstrate the components of control circuit schematics to include: a. a simple control circuit b. control devices with multiple contacts	**Career Ready Practice:** 1, 2, 4, 5, 9, 10

Understand, apply, and evaluate the fundamentals of motor controls and schematics.	2. Define, explain, and demonstrate the magnetic controls to include: a. electromagnetic control b. power sources for the coil and control circuit c. coil applications d. remote control-introduction e. lighting contactor f. feeder disconnect contactor with automatic control 3. Define, explain, and demonstrate parts of a magnetic motor starter to include: a. magnetic motor starter b. other overload protection methods c. auxiliary contacts d. motor starter add-on accessory devices 4. Work in teams to define, explain, and demonstrate basic control circuits to include: a. 2-wire control circuits b. 3-wire control circuits c. multiple start-stop pushbutton stations d. option of using a 2- or 3-wire circuit in one diagram 5. Define, explain, and demonstrate the overcurrent protection for control circuits based on the NECs to include: a. protection for control circuits b. common (tapped) vs. separate control circuits c. control conductor sizes 16 AWG and 18 AWG d. control transformer protection e. other standard control circuit overcurrent protection arrangements 6. Work in teams to define, explain, and demonstrate the indicator (Pilot) light and illuminated pushbuttons to include: a. pilot (indicator) lights b. typical applications for pilot lights in control circuits c. Illuminated pushbuttons 7. Work in teams to define, explain, and demonstrate the selector switches and truth tables to include: a. truth tables b. two-position selector switch c. three-position selector switch d. selector switches and truth tables e. selector switches-variations 8. Discuss binary transition to numbers in relation to gates: a. AND b. OR c. NOR	**CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.1 4.2 Problem Solving & Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health & Safety: 6.8, 6.12, 6.13, 6.15, 6.16 Leadership & Teamwork: 9.7 Technical Knowledge & Skills: 10.1, 10.3 Demonstration & Application: 11.1 **CTE Pathway:** B4.1, B5.1, B5.2, B5.8, B5.9, B7.3, B7.4, B7.5, B7.6

(14 hours)	d. NAND 9. Pass a Motors Controls & Schematic assessment with an 80% score or higher.	
N. REVERSING CONTROLS Understand, apply, and evaluate the concepts, components, and schematic diagrams for reversing motor control circuits. (2 hours)	1. Work in teams to define, explain, and demonstrate the reversing control for three-phase motors to include: a. forward and reverse contactors b. mechanical interlocking devices c. electrical interlock for magnetic reversing controls d. combined interlock methods for reversing starters e. wiring a reversing control pushbutton station f. wiring a reversing control with a selector switch 2. Work in teams to define, explain, and demonstrate the reversing controls with indicator (Pilot) lights for three-phase motors to include adding: a. forward and reverse pilot lights b. alternate pilot light connection points 3. Work in teams to define, explain, and demonstrate reversing controls with limit switches for three-phase motors to include: a. reversing controls with limit switches used to automatically stop a motor b. reversing controls-limit switches for automatic forward and reverse c. reversing controls and limit switches for garage door applications d. forward-reverse control with 2-wire circuits 4. Work in teams to define, explain, and demonstrate reversing single-phase motors to include: a. types of motors b. reversing control circuit c. sequence of operation 5. Pass a Reversing Controls assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 4, 5, 9, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2 Problem Solving & Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health & Safety: 6.8, 6.12, 6.13, 6.15, 6.16 Leadership & Teamwork: 9.7 Technical Knowledge & Skills: 10.1, 10.3 Demonstration & Application: 11.1 **CTE Pathway:** B4.1, B5.1, B5.2, B5.8, B5.9, B7.3, B7.4, B7.5, B7.6
O. CONTROLS FOR MULTIPLE MOTORS	1. Work in teams to define, explain, and demonstrate the sequencing control to include controls for sequencing multiple motors.	**Career Ready Practice:** 1, 2, 4, 5, 9, 10

Understand, apply, and evaluate the motor control systems that incorporate sequencing control and a master stop function. (2 hours)	2. Work in teams to define, explain, and demonstrate the master stop function to include: a. master or emergency stop controls for multiple motors b. factory installed jumpers c. types of pushbuttons 3. Pass a Reversing Controls assessment with an 80% score or higher.	**CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2 Problem Solving & Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health & Safety: 6.8, 6.12, 6.13, 6.15, 6.16 Leadership & Teamwork: 9.7 Technical Knowledge & Skills: 10.1, 10.3 Demonstration & Application: 11.1 **CTE Pathway:** B4.1, B5.1, B5.2, B5.8, B5.9, B7.3, B7.4, B7.5, B7.6
P. MOTOR CONTROL STATION Understand, apply, and evaluate the appropriate disconnecting means for motors and controllers in electrical schematics.	1. Define and explain the motor and controller disconnecting means in schematics based on the NECs to include: a. motor controllers and disconnects b. disconnect for separate control circuit 2. Define and explain miscellaneous motor control circuits to include: a. combining devices and functions for motor control circuits b. Control Relay (CR) c. selector switch pushbutton 3. Pass a Reversing Controls assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 4, 11 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.1, 4.2 Health & Safety:

(10 hours)		6.2, 6.3, 6.8, 6.11 Technical Knowledge & Skills: 10.1 **CTE Pathway:** B4.5, B5.2, B6.2, B7.1
Q. MOTOR WINDINGS Understand, apply, and evaluate a single-phase motor and a three-phase motor. (2 hours)	1. Describe motor winding configurations for different voltage ratings. 2. Define, explain, and work in teams to demonstrate the motor winding connections based on manufacturer specifications to include: a. three-phase motors b. dual-voltage, nine lead, three-phase motors c. single-phase, dual-voltage motors 3. Work in teams to demonstrate how to wire high/low voltage motors based on available voltage sources. 4. Work in teams using Digital Multimeter (DMM) to evaluate motor windings. 5. Pass a Motor Windings assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 4, 5, 9, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2 Problem Solving & Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health & Safety: 6.2, 6.4, 6.11, 6.12, 6.13, 6.14, 6.15, 6.16 Leadership & Teamwork: 9.7 Technical Knowledge & Skills: 10.1, 10.3 Demonstration & Application: 11.1 **CTE Pathway:** B 2.3, B2.4, B4.1, B4.6, B5.8, B5.9, B7.3, B7.4, B7.6

R. MOTORS, MOTOR CIRCUITS, & CONTROLLERS Understand, apply, and evaluate the appropriate disconnecting means for motors and controllers in electrical schematics based on Article 430 of the National Electrical Codes (NEC).	1. Discuss the importance of ethical and legal practices pertaining to the NEC. 2. Define and explain the general and conductor sizing based on the following NECs: a. 430.1 scope b. 430.2 definitions c. 430.6 table FLC vs. motor nameplate current rating d. 430.14 location of motors e. 430.17 highest rated motor f. 430.22 single motor conductor size g. 430.24 several motor-conductor sizes 3. Define and explain the motor and branch-circuit overload protection based on the following NECs: a. 430.31 overload b. 430.32 overload sizing for continuous-duty motors 4. Define and explain the branch-circuit short-circuit and ground fault protection based on the following NECs: a. 430.51 general b. 430.52 branch-circuit short-circuit and ground-fault protection c. 430.55 combined overcurrent protective device 5. Define and explain the feeder, short-circuit and ground-fault protection to include NEC 430.62 motor feeder protection. 6. Define and explain the motor control circuits based on the following NECs: a. 430.72 overcurrent protection for control circuits b. 430.75 disconnect for control circuits 7. Define and explain motor controllers using NEC 430.83 motor controller horsepower rating. 8. Define and explain disconnecting means based on the following NECs: a. 430.102 disconnect location b. 430.107 readily accessible c. 430.109 type of disconnecting means 9. Define and explain adjustable-speed drive systems based on the following NECs: a. 430.120 general b. 430.122 conductor sizing c. 430.124 overload protection d. 430.128 disconnecting means e. 430.130 branch-circuit short-circuit and ground-fault protection 10. Define and explain tables based on the following NECs: a. 430.248 full-load current, single-phase motors	**Career Ready Practice:** 1, 2, 4, 7, 8, 11 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.1, 4.2, 4.5 Health & Safety: 6.2, 6.11, 6.12 Responsibility & Flexibility: 7.2 Ethics & Legal Responsibilities: 8.2, 8.3 Technical Knowledge & Skills: 10.1, 10.2 **CTE Pathway:** B4.5, B5.2, B7.1

(4 hours)	b. 430.250 full-load current, three-phase motors 11. Pass a Motors, Motor Circuits, & Controllers assessment with an 80% score or higher.	
S. EMPLOYABILITY SKILLS & RESUME PREPARATION Understand, apply, and evaluate the employability skills and résumé preparation. (2 hours)	1. Understand and define employer requirements for soft skills to include: a. attitude toward work b. communication and collaboration c. critical thinking, problem solving, and decision-making d. customer service e. diversity in the workplace f. flexibility and adaptability g. interpersonal skills h. leadership and responsibility i. punctuality and attendance j. quality of work k. respect, cultural and diversity differences l. teamwork m. time management n. trust and ethical behavior o. work ethics 2. Develop a career plan that reflects career interests, pathways, and post-secondary options. 3. Create/revise a résumé, cover letter, and/or portfolio. 4. Understand the importance of assessing social media account content for professionalism. 5. Understand the importance of the continuous upgrading of job skills as it relates to: a. certification, regulatory body, licensure, and/or renewal b. professional organizations/events c. industry associations and/or organized labor	**Career Ready Practice:** 1, 2, 3, 4, 5, 7, 8, 9 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.4. 2.5 Career Planning & Management: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.8, 3.9 Technology: 4.1, 4.2 Problem Solving & Critical Thinking: 5.1, 5.4 Responsibility & Flexibility: 7.2, 7.3, 7.4, 7.7 Ethics & Legal Responsibilities: 8.1, 8.3, 8.4, 8.5 Leadership & Teamwork: 9.1, 9.2, 9.3, 9.4, 9.6 Technical Knowledge & Skills: 10.1, 10.3 Demonstration & Application: 11.2, 11.5 **CTE Pathway:** B1.7

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