Apprenticeship and Industry Training

Apprenticeship Curriculum Guide Companion Document

Electrician

Alberta Government

Apprenticeship and Industry Training

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Program Guide

Introduction

Apprenticeship and Industry Training (AIT) utilizes the curriculum guide as a document to guide and direct the developers of training and lesson plans. The curriculum guide is written to reflect and identify competence-based learning through supporting competence statements. Although this model provides more flexibility and responsiveness for the stakeholders, it creates challenges to developers of lesson plans and assessments.

The Purpose

The purpose of this document is to expand on competence and supporting compentence statements by identifying and providing outcome and objective statements that are associated with the supporting competence statement.

Outcome Statements

Outcome statements are an observable major task or work activity that an entry-level journeyperson performs for compensation.

Objective Statements

Objective statements are the knowledge or skill an apprentice learns or demonstrates while attending in-classroom instruction. They support achievement of the outcome statement by the apprentice.

Course Content Overview

The term ***"In Context"*** indicates that the supporting competence will become integrated learning and/or utilized as a component of the competence statement. It will **not** have an assigned weighting and will **not** be assessed as an examination item.

PERIOD ONE COURSE CONTENT

CORE COMPETENCE ONE: *Foundational Skills, Job Responsibilities, and Procedures*

Competence Statement:	Supporting Competences:		
	A	***B***	***C***
Apply foundational skills essential to convey and receive critical training and workplace information.	Select, use, and maintain personal protective equipment.	Demonstrate safety awareness and safe work practices.	Demonstrate knowledge and understanding of working at heights.
	D	***E***	***F***
	Demonstrate knowledge and understanding of material handling.	Use drawings, diagrams, schematics, and specifications.	Organizes tasks and work area
	G	***H***	***I***
	Apply quality workmanship practices	Demonstrate critical thinking skills. ***In Context***	Demonstrate numeracy skills. ***In Context***
	J	***K***	***L***
	Demonstrate literacy skills. ***In Context***	Demonstrate digital literacy skills. ***In Context***	Demonstrate communication skills. ***In Context***

CORE COMPETENCE TWO: *Tools, Equipment, and Instruments*

Competence Statement:	Supporting Competences:		
	A	***B***	***C***
Demonstrate knowledge, understanding and proficiency regarding the use and maintenance of tools, equipment, and instruments.	Select, use, and maintain hand tools. ***In Context***	Select, use, and maintain power tools. ***In Context***	Select, use, and maintain speciality tools. ***In Context***
	D	***E***	***F***
	Select, use, and maintain measurement instruments.	Select, use, and maintain testing equipment. ***In Context***	Select, use, and maintain diagnostic equipment. ***In Context***

CORE COMPETENCE THREE: *Codes and Standards*

Competence Statement:	Supporting Competences:		
	A	***B***	***C***
Demonstrate knowledge, understanding and proficiency when interpreting and applying codes and/or standards.	Interpret and apply the CE Code.	Interpret and apply the electrical STANDATA.	Interpret and apply jurisdictional bylaws, standards, and codes.

CORE COMPETENCE FOUR: Electrical Theory and Circuit Fundamentals

Competence Statement:	Supporting Competences:
	A
Demonstrate knowledge, understanding, and application of electrical theory, circuit fundamentals and electronics.	Connect and analyze resistive circuits.

CORE COMPETENCE FIVE: Electrical Systems

Competence Statement:	Supporting Competences:		
	A	***B***	***C***
Demonstrate knowledge, understanding and proficiency regarding the identification, installation, inspection, verification, testing, analysis, troubleshooting, altering, repair, commissioning, maintaining, operating, and energizing of electrical systems.	Identify electrical systems.	Install electrical systems.	Inspect electrical systems.
			In Context
	D		
	Analyze electrical systems.		

PERIOD TWO COURSE CONTENT

CORE COMPETENCE ONE: *Foundational Skills, Job Responsibilities, and Procedures*

Competence Statement:	Supporting Competences:		
Apply foundational skills essential to convey and receive critical training and workplace information.	***A*** Select, use, and maintain personal protective equipment. ***In Context***	***B*** Demonstrate safety awareness and safe work practices. ***In Context***	***C*** Demonstrate knowledge and understanding of working at heights. ***In Context***
	D Demonstrate knowledge and understanding of material handling. ***In Context***	***E*** Use drawings, diagrams, schematics, and specifications.	***F*** Organizes tasks and work area ***In Context***
	G Apply quality workmanship practices ***In Context***	***H*** Demonstrate critical thinking skills. ***In Context***	***I*** Demonstrate numeracy skills. ***In Context***
	J Demonstrate literacy skills. ***In Context***	***K*** Demonstrate digital literacy skills. ***In Context***	***L*** Demonstrate communication skills. ***In Context***

CORE COMPETENCE TWO: *Tools, Equipment, and Instruments*

Competence Statement:	Supporting Competences:		
Demonstrate knowledge, understanding and proficiency regarding the use and maintenance of tools, equipment, and instruments.	***A*** Select, use, and maintain hand tools. ***In Context***	***B*** Select, use, and maintain power tools. ***In Context***	***C*** Select, use, and maintain speciality tools. ***In Context***
	D Select, use, and maintain measurement instruments. ***In Context***	***E*** Select, use, and maintain testing equipment. ***In Context***	***F*** Select, use, and maintain diagnostic equipment. ***In Context***

CORE COMPETENCE THREE: *Codes and Standards*

Competence Statement:	Supporting Competences:		
Demonstrate knowledge, understanding and proficiency when interpreting and applying codes and/or standards.	***A*** Interpret and apply the CE Code.	***B*** Interpret and apply the electrical STANDATA. ***In Context***	***C*** Interpret and apply jurisdictional bylaws, standards, and codes. ***In Context***

CORE COMPETENCE FOUR: Electrical Theory and Circuit Fundamentals

Competence Statement:

Demonstrate knowledge, understanding, and application of electrical theory, circuit fundamentals and electronics.

Supporting Competences:

A

Connect and analyze direct current (DC) circuits.

In Context

B

Connect and analyze single-phase alternating current (AC) circuits.

CORE COMPETENCE FIVE: Electrical Systems

Competence Statement:

Demonstrate knowledge, understanding and proficiency regarding the identification, installation, inspection, verification, testing, analysis, troubleshooting, altering, repair, commissioning, maintaining, operating, and energizing of electrical systems.

Supporting Competences:

A

Identify electrical systems.

B

Install electrical systems.

C

Inspect electrical systems.

In Context

D

Verify electrical systems.

In Context

E

Test electrical systems.

In Context

F

Analyze electrical systems.

G

Troubleshoot electrical systems

PERIOD THREE COURSE CONTENT

CORE COMPETENCE ONE: *Foundational Skills, Job Responsibilities, and Procedures*

Competence Statement:	Supporting Competences:		
Apply foundational skills essential to convey and receive critical training and workplace information.	***A*** Select, use, and maintain personal protective equipment. ***In Context***	***B*** Demonstrate safety awareness and safe work practices. ***In Context***	***C*** Demonstrate knowledge and understanding of working at heights. ***In Context***
	D Demonstrate knowledge and understanding of material handling. ***In Context***	***E*** Use drawings, diagrams, schematics, and specifications. ***In Context***	***F*** Organizes tasks and work area ***In Context***
	G Apply quality workmanship practices ***In Context***	***H*** Demonstrate critical thinking skills. ***In Context***	***I*** Demonstrate numeracy skills. ***In Context***
	J Demonstrate literacy skills. ***In Context***	***K*** Demonstrate digital literacy skills. ***In Context***	***L*** Demonstrate communication skills. ***In Context***

CORE COMPETENCE TWO: *Tools, Equipment, and Instruments*

Competence Statement:	Supporting Competences:		
Demonstrate knowledge, understanding and proficiency regarding the use and maintenance of tools, equipment, and instruments.	***A*** Select, use, and maintain hand tools. ***In Context***	***B*** Select, use, and maintain power tools. ***In Context***	***C*** Select, use, and maintain speciality tools. ***In Context***
	D Select, use, and maintain measurement instruments.	***E*** Select, use, and maintain testing equipment. ***In Context***	***F*** Select, use, and maintain diagnostic equipment. ***In Context***

CORE COMPETENCE THREE: *Codes and Standards*

Competence Statement:	Supporting Competences:		
Demonstrate knowledge, understanding and proficiency when interpreting and applying codes and/or standards.	***A*** Interpret and apply the CE Code.	***B*** Interpret and apply the electrical STANDATA. ***In Context***	***C*** Interpret and apply jurisdictional bylaws, standards, and codes. ***In Context***

CORE COMPETENCE FOUR: Electrical Theory and Circuit Fundamentals

Competence Statement:	Supporting Competences:		
Demonstrate knowledge, understanding, and application of electrical theory, circuit fundamentals and electronics.	***A*** Connect and analyze direct current (DC) circuits. ***In Context***	***B*** Connect and analyze single-phase alternating current (AC) circuits. ***In Context***	***C*** Connect and analyze three-phase alternating current (AC) circuits.

CORE COMPETENCE FIVE: Electrical Systems

Competence Statement:	Supporting Competences:		
Demonstrate knowledge, understanding and proficiency regarding the identification, installation, inspection, verification, testing, analysis, troubleshooting, altering, repair, commissioning, maintaining, operating, and energizing of electrical systems.	***A*** Identify electrical systems.	***B*** Install electrical systems. ***In Context***	***C*** Inspect electrical systems. ***In Context***
	D Verify electrical systems. ***In Context***	***E*** Test electrical systems. ***In Context***	***F*** Analyze electrical systems.
	G Troubleshoot electrical systems.		

PERIOD FOUR COURSE CONTENT

CORE COMPETENCE ONE: *Foundational Skills, Job Responsibilities, and Procedures*

Competence Statement:

Apply foundational skills essential to convey and receive critical training and workplace information.

Supporting Competences:

A Select, use, and maintain personal protective equipment. — ***In Context***	***B*** Demonstrate safety awareness and safe work practices.	***C*** Demonstrate knowledge and understanding of working at heights. — ***In Context***
D Demonstrate knowledge and understanding of material handling. — ***In Context***	***E*** Use drawings, diagrams, schematics, and specifications	***F*** Organizes tasks and work area — ***In Context***
G Apply quality workmanship practices	***H*** Demonstrate critical thinking skills. — ***In Context***	***I*** Demonstrate numeracy skills. — ***In Context***
J Demonstrate literacy skills. — ***In Context***	***K*** Demonstrate digital literacy skills. — ***In Context***	***L*** Demonstrate communication skills. — ***In Context***
M Demonstrate mentorship skills		

CORE COMPETENCE TWO: *Tools, Equipment, and Instruments*

Competence Statement:

Demonstrate knowledge, understanding and proficiency regarding the use and maintenance of tools, equipment, and instruments.

Supporting Competences:

A Select, use, and maintain hand tools. — ***In Context***	***B*** Select, use, and maintain power tools. — ***In Context***	***C*** Select, use, and maintain speciality tools. — ***In Context***
D Select, use, and maintain measurement instruments. — ***In Context***	***E*** Select, use, and maintain testing equipment. — ***In Context***	***F*** Select, use, and maintain diagnostic equipment. — ***In Context***

CORE COMPETENCE THREE: *Codes and Standards*

Competence Statement:

Demonstrate knowledge, understanding and proficiency when interpreting and applying codes and/or standards.

Supporting Competences:

A Interpret and apply the CE Code.	***B*** Interpret and apply the electrical STANDATA. — ***In Context***	***C*** Interpret and apply jurisdictional bylaws, standards, and codes. — ***In Context***

CORE COMPETENCE FOUR: Electrical Theory and Circuit Fundamentals

Competence Statement:

Demonstrate knowledge, understanding, and application of electrical theory, circuit fundamentals and electronics.

Supporting Competences:

A	B	C
Connect and analyze resistive circuits.	Connect and analyze single-phase alternating current (AC) circuits.	Connect and analyze three-phase alternating current (AC) circuits.
In Context	***In Context***	***In Context***

D
Connect and analyze electronics

CORE COMPETENCE FIVE: Electrical Systems

Competence Statement:

Demonstrate knowledge, understanding and proficiency regarding the identification, installation, inspection, verification, testing, analysis, troubleshooting, altering, repair, commissioning, maintaining, operating, and energizing of electrical systems.

Supporting Competences:

A	B	C
Identify electrical systems.	Install electrical systems.	Inspect electrical systems.
	In Context	***In Context***

D	E	F
Verify electrical systems.	Test electrical systems.	Analyze electrical systems.
	In Context	

G	H	I
Troubleshoot electrical systems.	Alter electrical systems.	Repair electrical systems.
	In Context	***In Context***

J	K	L
Commission electrical systems.	Maintain electrical systems.	Operate electrical systems.
In Context	***In Context***	***In Context***

M
Energize electrical systems.
In Context

Period One
Course Content

(8 weeks – 240 hours)

Period One Core Competences	Weighting
Foundational Skills, Job Responsibilities and Procedures	**11%**
Tools, Equipment, and Instruments	**2%**
Codes and Standards	**19%**
Electrical Theory, Circuit Fundamentals and Electronics	**31%**
Electrical Systems	**37%**

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Weighting – 11%

An Electrician utilizes a host of foundational skills and abilities that will enable them to understand and perform their job responsibilities and apply procedures for everyday activities. These skills are acquired, practiced, and honed through a combination of personal and professional learning environments and are essential tools in the learner's working portfolio.

These supporting competences are observed, studied, and performed in all periods of the apprenticeship education program.

CS

Apply foundational skills essential to convey and receive critical training and workplace information.

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence		Taxonomy	Weighting
1A.	Select, use, and maintain personal protective equipment Outcomes for this supporting competence include: ***I. Apply legislation, regulations and practices ensuring safe work.*** 1. Demonstrate the application of the Occupational Health and Safety Act, Regulation and Code. 2. Describe the employer's and employee's role with Occupational Health and Safety (OHS) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations and related advisory bodies and agencies. 3. Describe industry practices for hazard assessment and control procedures. 4. Describe the responsibilities of worker and employers to apply emergency procedures. 5. Describe tradesperson attitudes with respect to housekeeping, personal protective equipment, and emergency procedures. 6. Describe the roles and responsibilities of employers and employees with the selection and use of personal protective equipment (PPE). 7. Maintain required PPE for tasks. 8. Use required PPE for tasks.	**I, II**	**7%**
1B.	Demonstrate safety awareness and safe work practices. Outcomes for this supporting competence include: ***I. Apply safe work practices for electricians.*** 1. Identify electrical hazards. 2. Identify personal protective equipment requirements. 3. Describe inspection and maintenance procedures for personal protective equipment. 4. Identify arc flash hazards. 5. Describe methods to minimize arc flash hazards. 6. Describe safe work practices to prevent electrical shock. 7. Describe personal safety lock-out and tag-out procedures.	**I, II**	**22%**
1C.	Demonstrate knowledge and understanding of working at heights. Outcomes for this supporting competence include: ***I. Use industry standard practices for climbing and working at heights.*** 1. Use PPE for climbing and working at heights.	**I**	**2%**
1D.	Demonstrate knowledge and understanding of material handling. Outcomes for this supporting competence include: ***I. Use industry standard practices for lifting, rigging, and hoisting.*** 1. Describe manual lifting procedures. 2. Describe rigging hardware and associated safety factors. 3. Select equipment for rigging loads. 4. Describe hoisting and load moving procedures. 5. Maintain personal protective equipment (PPE) for lifting and load moving equipment.	**I, II**	**5%**

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence	Taxonomy	Weighting
1E. Use drawings, diagrams, schematics, and specifications.	**I, II, III**	**50%**

Outcomes for this supporting competence include:

I. Interpret orthographic projections, block, wiring and schematic diagrams.

1. Describe the basic views of objects using orthographic projection.
2. Identify basic orthographic projections to views of a building.
3. Identify the lines found on a drawing.
4. Describe a block diagram and a wiring diagram.
5. Interpret electrical schematic drawings.

II. Identify construction drawing components.

1. Interpret dimensions from a drawing.
2. Determine dimensions from a drawing using the scale.
3. Identify electrical symbols.
4. Identify abbreviations used on drawings.
5. Interpret technical terms used on drawings.
6. State the different types of drawings and their uses in a set of construction drawings.
7. Describe the disciplines and types of drawings used in a set of construction drawings.

III. Interpret single dwelling electrical construction drawings.

1. Interpret information from a drawing.
2. Interpret a drawing of an overhead service for a single dwelling.
3. Interpret a drawing of an underground service for a single dwelling.
4. Interpret a partial floor plan of a single dwelling electrical installation.
5. Create a material estimate.
6. Calculate the main service requirements for a single dwelling.

1F. Organizes tasks and work area	**I**	**7%**

Outcomes for this supporting competence include:

I. Apply industry standard practices for hazardous materials and fire protection.

1. Describe roles, responsibilities, features, and practices related to the Workplace Hazardous Materials Information System (WHMIS) program.
2. Describe three key elements of WHMIS.
3. Describe handling, storing and transporting procedures for hazardous material.
4. Describe venting procedures when working with hazardous materials.
5. Describe hazards, classes, procedures, and equipment related to fire protection.

1G. Apply quality workmanship practices	**I**	**7%**

Outcomes for this supporting competence include:

I. Manage an apprenticeship to earn journeyperson certification.

1. Describe the contractual responsibilities of the apprentice, sponsor and Alberta Apprenticeship and Industry Training.
2. Describe the purpose of the apprentice record book.
3. Describe the procedure for changing sponsors during an active apprenticeship.
4. Describe the purpose of the curriculum guide.
5. Describe the procedure for progressing through an apprenticeship.
6. Describe advancement opportunities in this trade.

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures			
Supporting Competence		**Taxonomy**	**Weighting**
1H.	Demonstrate critical thinking skills.		**In Context**
1I.	Demonstrate numeracy skills.		**In Context**
1J.	Demonstrate literacy skills.		**In Context**
1K.	Demonstrate digital literacy skills.		**In Context**
1L.	Demonstrate communication skills.		**In Context**

Core Competence 2: Tools, Equipment, and Instruments

Weighting – 2%

An Electrician employs a variety of tools, equipment, and instruments throughout their working day. These items extend an individual's ability to perform activities and functions. Tools, equipment, and instruments come in many forms and configurations and require training and knowledge to utilize them in a safe, effective, and intended manner.

This section will focus on knowledge and procedures associated with tools, equipment, and instruments. Components of this section will be integrated and incorporated throughout all periods of the apprenticeship education program.

CS

Demonstrate knowledge, understanding and proficiency regarding the use and maintenance of tools, equipment, and instruments.

Core Competence 2: Tools, Equipment, and Instruments			
Supporting Competence		**Taxonomy**	**Weighting**
2A.	Select, use, and maintain hand tools.		**In Context**
2B.	Select, use, and maintain power tools.		**In Context**
2C.	Select, use, and maintain speciality tools.		**In Context**

Core Competence 2: Tools, Equipment, and Instruments			
Supporting Competence		**Taxonomy**	**Weighting**
2D.	Select, use, and maintain measurement instruments. Outcomes for this supporting competence include: ***I. Use measurement equipment.*** 1. Identify measurement equipment. 2. State the applications of various meters. 3. Identify hazards associated with meter usage. 4. Connect and demonstrate proper range selection and connections of voltmeters, ammeters, ohmmeters and megohmmeters.	***I, II***	***100%***
2E.	Select, use, and maintain testing equipment.		**In Context**
2F.	Select, use, and maintain diagnostic equipment.		**In Context**

Core Competence 3: Codes and Standards

Weighting – 19%

Electricians use and apply codes and standards every day in their work environment. Electrical codes and standards are crucial guidelines that govern the design, installation, and maintenance of electrical systems to ensure safety, efficiency, and compliance with regulations. These codes and standards are established to safeguard the well-being of both the public and electrical professionals, maintaining a high standard of electrical work across the province.

This section will focus on an introduction to electrical codes and standards with an emphasis on single dwellings.

Demonstrate knowledge, understanding and proficiency when interpreting and applying codes and/or standards.

Core Competence 3: Codes and Standards			
Supporting Competence		**Taxonomy**	**Weighting**
3A.	Interpret and apply the CE Code. Outcomes for this supporting competence include: ***I. Use electrical codes and standards.*** 1. Explain the purpose of the CE Code Part I. 2. Describe the procedures for the acceptance of the CE Code by Alberta. 3. Describe the function of the electrical STANDATA. 4. Describe the organizational layout of the CE Code.	**I, II, III**	**100%**

Core Competence 3: Codes and Standards

Supporting Competence	Taxonomy	Weighting

5. Locate specific information in the CE Code using a variety of methods.
6. Identify those responsible for an electrical installation.

II. Interpret the general rules of the CE Code.

1. Identify CE Code terms.
2. Describe the administrative rules.
3. Describe the technical requirements.

III. Determine the conductors required for installations.

1. Identify related CE Code terms.
2. Identify requirements for General subsection of conductors.
3. Apply rules to determine conductor sizes, using the appropriate tables and appendices.
4. Determine the allowable ampacity of a conductor given load current and conditions of use.
5. Determine the allowable ampacity of flexible cords and equipment wire and conditions of use.
6. Identify neutral conductors and determine their size.
7. State the CE Code standards for conductor colours.

IV. Determine the components, installation methods, grounding, and bonding for a single dwelling.

1. Identify related CE Code terms.
2. Describe the wiring methods used for the installation of overhead services.
3. Describe the wiring methods used for the installation of underground services.
4. Describe the requirements for service equipment in a single dwelling.
5. Determine the grounding requirements for a single dwelling.
6. Determine the bonding requirements for a single dwelling.

V. Determine the loading on services, feeders, and branch circuits for single dwellings.

1. Identify related CE Code terms.
2. Determine the minimum ampacity of service or feeder conductors supplying a single dwelling.
3. Determine the minimum required number of branch circuit positions for a single dwelling.
4. Determine the ampacity requirements for branch circuit conductors and ampere ratings of overcurrent devices applicable to a single dwelling.

VI. Determine installation wiring methods.

1. Identify related CE Code terms.
2. Identify the General Requirements.
3. Describe the conditions for use of exposed wiring located outdoors.
4. Describe the conditions for use of non-metallic sheathed cable.
5. Describe the conditions for use of armoured and mineral-insulated cable.
6. Describe the conditions for use of raceways.
7. Describe the installation of boxes, cabinets, and outlets.

VII. Determine electrical requirements for a single dwelling.

1. Identify related CE Code terms.
2. Describe the operation and applications of GFCIs and AFCIs.
3. Identify receptacle configurations.
4. Determine the branch circuit and receptacle requirements for areas of a single dwelling.
5. Determine the branch circuit and receptacle requirements for kitchens and bath.
6. Determine where the disconnecting means for a furnace must be installed.

VIII. Determine CE Code requirements for luminaires.

1. Define terms related to lighting and lighting installations.
2. Describe the different types of electric lighting sources.
3. Describe the requirements for interior and exterior lighting equipment.

Core Competence 3: Codes and Standards			
Supporting Competence		**Taxonomy**	**Weighting**
	4. Describe factors for the installation of lighting equipment. 5. Describe the methods of wiring various types of lighting equipment. 6. Describe the bonding requirements of lighting equipment. 7. Identify the ratings and control methods of lighting equipment.		
3B.	Interpret and apply the electrical STANDATA.	**In Context**	
3C.	Interpret and apply jurisdictional bylaws, standards, and codes.	**In Context**	

Core Competence 4: Electrical Theory, Circuit Fundamentals and Electronics

Weighting – 31%

Electrical theory, circuit fundamentals, and electronics form the foundational knowledge base for electricians, providing the understanding and skills necessary to design, install, and maintain electrical systems. These concepts are essential for electricians to navigate the complexities of electrical work, troubleshoot issues, and ensure the safety and functionality of electrical installations.

This section will focus on the introduction of electrical theory concepts with an emphasis on resistive circuits.

Demonstrate knowledge, understanding, and application of electrical theory, circuit fundamentals and electronics.

Core Competence 4: Electrical Theory, Circuit Fundamentals and Electronics			
Supporting Competence		**Taxonomy**	**Weighting**
4A.	Connect and analyze resistive circuits. Outcomes for this supporting competence include: ***I. Predict how changes in the value of voltage, current or resistance affect a circuit.*** 1. Describe an electric current. 2. Describe voltage. 3. Describe resistance and state and apply Ohm's Law. 4. Recognize and apply formulas being used in electrical theory calculations. 5. Calculate equations in relation to Ohm's Law. 6. Connect and analyze relationships between voltage, current and resistance according to Ohm's Law.	**I, II, III**	**100%**

Core Competence 4: Electrical Theory, Circuit Fundamentals and Electronics

Supporting Competence	Taxonomy	Weighting

II. Connect and analyze a series resistive circuit.

1. Identify a series circuit.
2. Calculate resistance in a series circuit.
3. State and apply Kirchhoff's Voltage Law in a series circuit.
4. Calculate current in a series circuit.
5. Determine circuit values by applying ratio and proportion.
6. Determine the voltage drop across closed-or-open components in a series circuit.
7. Connect and analyze Kirchhoff's Voltage Law in a series resistive circuit.

III. Connect and analyze a parallel resistive circuit.

1. Describe a parallel circuit.
2. Calculate resistance in a parallel circuit.
3. State and apply Kirchhoff's Current Law to a parallel circuit.
4. Describe the effects of an open circuit in a parallel circuit.
5. Connect and analyze Kirchhoff's Current Law in a parallel resistive circuit.

IV. Connect and analyze a series-parallel resistive circuit.

1. Identify resistors that are in series.
2. Identify resistors that are in parallel.
3. Calculate the total resistance of a series-parallel circuit.
4. Apply Kirchhoff's Current Law to a series-parallel circuit.
5. Apply Kirchhoff's Voltage Law to a series-parallel circuit.
6. Solve problems involving series-parallel circuits.
7. Connect and analyze the relationship of current, voltage and resistance in each part of a series-parallel circuit.

V. Connect and analyze an Edison 3-wire system.

1. Identify the characteristics of an Edison 3-wire circuit.
2. Explain the properties of an Edison 3-wire circuit.
3. Describe and calculate the effects of a high resistance or broken neutral in an Edison 3-wire circuit.
4. Connect and analyze the effects of a high resistance or broken neutral in an Edison 3-wire system.

VI. State and analyze the relationship between work, energy, power, and efficiency.

1. Describe mass, weight, and force.
2. Describe work, energy, and power.
3. Describe electrical relationships of work, energy, and power.
4. Calculate efficiency, voltage drop and line loss.
5. Connect and analyze the power formulae.

Core Competence 5: Electrical Systems

Weighting – 37%

Electrical systems serve as the intricate network of components and wiring that enables the generation, distribution, and utilization of electricity within various structures. For electricians, a comprehensive understanding of electrical systems is paramount, as it forms the basis for their work in designing, installing, and maintaining safe and efficient electrical installations.

This section will focus on the EMF sources, alarms and detection systems, control circuit components and related equipment.

CS	Demonstrate knowledge, understanding and proficiency regarding the preparation, installation, inspection, verification, testing, analysis, troubleshooting, altering, repairing, commissioning, maintaining, operating, and energizing of electrical systems.

Core Competence 5: Electrical Systems

Supporting Competence	Taxonomy	Weighting

5A. Identify electrical systems. — I — 24%

Outcomes for this supporting competence include:

I. Identify the methods of producing Electromotive Force (EMF).

1. Identify the production of EMF by using chemicals.
2. Identify the production of EMF by using heat.
3. Identify the production of EMF by using pressure.
4. Identify the production of EMF by using light.
5. Identify the production of EMF by using magnetism.
6. Identify the production of EMF by using electrostatics.

II. Explain the generation of electricity in AC and DC generators.

1. Describe magnetism.
2. Describe electromagnetism.
3. Describe generator construction.
4. Describe how generators produce voltage.
5. Describe how generators can be connected to a load.

III. Identify resistor types and ratings.

1. Describe two categories of resistors and their construction.
2. Describe the methods used to determine the ratings of fixed resistors.
3. Determine the resistance of a resistor using a four-band colour code chart.
4. Describe surface-mount resistor number systems.

IV. Describe extra low voltage switching circuits.

1. Describe extra-low voltage switching systems.
2. State the advantages of extra-low voltage switching.
3. Describe the operation of an extra-low voltage switching system.
4. Describe Power over Ethernet infrastructure and applications.

5B. Install electrical systems. — I, II, III — 21%

Outcomes for this supporting competence include:

I. Splice, tap and terminate conductors.

1. Describe four classes of terminations or connections used in the electrical trade.
2. Describe the proper method for stripping conductors and insulating splices.
3. Describe three common wire connections.
4. Describe the techniques used for mechanical and compression splices and terminations.
5. Describe the problems specific to aluminium conductor splices and terminations.
6. Splice, tap and terminate conductors.

II. Identify the properties of conductors, semiconductors, and insulators.

1. State the types and forms of conductor materials.
2. Describe the electrical properties of conductors, semiconductors, and insulators.
3. Describe the factors affecting resistance.
4. Calculate the cross-sectional area and resistance of conductors.
5. Calculate the approximate voltage drop due to conductor resistance.

Core Competence 5: Electrical Systems

Supporting Competence	Taxonomy	Weighting
III. Identify the requirements for installation and maintenance of batteries. 1. Describe the construction and maintenance of lead-acid batteries. 2. Describe the construction and maintenance of a nickel-cadmium battery. 3. Describe the construction and maintenance of a lithium battery. 4. Describe the hazards and precautions to be observed when charging batteries. 5. Describe battery bank configuration. 6. Identify CE Code standards for battery rooms 7. Describe battery performance ratings. 8. Calculate the effects of battery internal resistance.		
5C. Verify electrical systems.		**In Context**
5D. Analyze electrical systems.	**I, II, III**	**55%**

Outcomes for this supporting competence include:

I. Explain photovoltaic electricity generation.
1. Describe photovoltaic electrical generation.
2. Describe photovoltaic systems.
3. Identify photovoltaic hazards.
4. Connect and analyze a photovoltaic system.

II. Design and connect switching circuits using schematic and wiring diagrams.
1. Draw symbols that are commonly used in schematic and wiring diagrams.
2. Describe applications of various types of switches.
3. Draw schematic and wiring diagrams for typical lighting circuits.
4. Describe how to connect a set of door chimes.
5. Connect and analyze the switching arrangement of various types of switches.

III. Connect and analyze relay control circuits.
1. Define specific terms that are used when referring to control circuits.
2. Identify the parts of a relay.
3. Describe the operating principle of a relay.
4. Draw the symbols that are used in control circuits.
5. Draw schematic and wiring diagrams using a relay.
6. Connect and analyze circuits using relays.

IV. Connect and analyze alarm systems and smoke alarms.
1. Identify various types of sensing and alarm devices used in alarm systems.
2. Describe the operation of a basic alarm system.
3. Identify the function and applications of detection systems.
4. Describe the operation of a fire alarm system.
5. Connect and analyze an alarm system.
6. Connect and analyze a smoke alarm system.

Period Two
Course Content

(8 weeks – 240 hours)

Period Two Core Competences	Weighting
Foundational Skills, Job Responsibilities and Procedures	**3%**
Tools, Equipment, and Instruments	**In Context**
Codes and Standards	**16%**
Electrical Theory, Circuit Fundamentals and Electronics	**45%**
Electrical Systems	**36%**

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Weighting – 3%

An Electrician utilizes a host of foundational skills and abilities that will enable them to understand and perform their job responsibilities and apply procedures for everyday activities. These skills are acquired, practiced, and honed through a combination of personal and professional learning environments and are essential tools in the learner's working portfolio.

These supporting competences are observed, studied, and performed in all periods of the apprenticeship education program.

CS

Apply foundational skills essential to convey and receive critical training and workplace information.

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence		Taxonomy	Weighting
1A.	Select, use, and maintain personal protective equipment		**In Context**
1B.	Demonstrate safety awareness and safe work practices.		**In Context**

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence		Taxonomy	Weighting
1C.	Demonstrate knowledge and understanding of working at heights.		In Context
1D.	Demonstrate knowledge and understanding of material handling.		In Context
1E.	Use drawings, diagrams, schematics, and specifications. Outcomes for this supporting competence include: ***I. Apply specifications to electrical installations.*** 1. State the purpose of specifications. 2. Describe the organization of specifications. 3. Extract specific information from specifications. ***II. Interpret commercial electrical construction drawings.*** 1. Identify the divisions of drawings and their applications. 2. Identify the different views and schedules that are typically found in drawings. 3. Extract information from a set of drawings.	I, II	100%
1F.	Organizes tasks and work area		In Context
1G.	Apply quality workmanship practices		In Context
1H.	Demonstrate critical thinking skills.		In Context
1I.	Demonstrate numeracy skills.		In Context
1J.	Demonstrate literacy skills.		In Context
1K.	Demonstrate digital literacy skills.		In Context
1L.	Demonstrate communication skills.		In Context

Core Competence 2: Tools, Equipment, and Instruments

Weighting – In Context

CS	Demonstrate knowledge, understanding and proficiency regarding the use and maintenance of tools, equipment, and instruments.

Core Competence 3: Codes and Standards

Weighting – 16%

Electrical codes and standards are crucial guidelines that govern the design, installation, and maintenance of electrical systems to ensure safety, efficiency, and compliance with regulations. These codes and standards are established to safeguard the well-being of both the public and electrical professionals, maintaining a high standard of electrical work across the province.

This section will focus on circuit classifications, electric vehicle charging, electric heating, and cooling with an emphasis on apartment and similar building requirements.

CS

Demonstrate knowledge, understanding and proficiency when interpreting and applying codes and/or standards.

Core Competence 3: Codes and Standards

Supporting Competence	Taxonomy	Weighting
3A. Interpret and apply the CE Code.	**I, II, III**	**100%**

Outcomes for this supporting competence include:

I. Determine the installation requirements for electric vehicle supply equipment.

1. Define related CE Code terms.
2. Determine the requirements for electric vehicle supply equipment.

II. Determine the installation requirements for electric space heating and air conditioning.

1. Define related CE Code terms.
2. Determine the requirements for sizing the demand of electrical space heating toward the main service.
3. Determine the requirements for sizing the branch circuit conductor and overcurrent for electrical space heating.
4. Determine the requirements for conductor size for residential air conditioning.

III. Determine the service, feeder, and branch circuit requirements of an apartment building.

1. Define related CE Code terms.
2. Calculate the overcurrent size and the minimum ampacity required for a feeder conductor to a dwelling unit in an apartment complex.
3. Determine the trade size of conduit required for the service or feeder conductors supplying a dwelling unit in an apartment or similar building.
4. Determine the demand load on a public panel board feeder conductor in an apartment complex.
5. Determine the demand load on a parking lot panel board feeder conductor.
6. Calculate the overcurrent size, the minimum ampacity, and the trade size conduit required for the main service conductors in an apartment complex.
7. Determine the required size of a raceway when conductors of different sizes are installed.

Core Competence 3: Codes and Standards

Supporting Competence		Taxonomy	Weighting
	IV. Determine the requirements of a service for an apartment and similar building. 1. Define related CE Code terms. 2. Determine the requirements for metering equipment for an apartment and similar building. 3. Determine the requirements for service protection and control equipment for apartments and similar buildings. 4. Determine the requirements for grounding and bonding of apartments and similar buildings. ***V. Determine wiring and equipment requirements for capacitor bank installations.*** 1. Determine the conductor sizes for capacitor installations. 2. Determine the rating of the overcurrent protection required for capacitor installations. 3. Determine the requirements for capacitor discharge circuits. 4. Determine the location and current rating of capacitor disconnecting means. 5. Calculate the rating or setting of the single-phase motor overload device in circuits where power factor correction capacitors are used on the load side of a motor controller. ***VI. Determine CE Code requirements for Pools, Mobile Homes, and Temporary Wiring.*** 1. Determine the regulations for electric installations for pools, tubs, and spas. 2. Determine the regulations for services and distribution facilities of mobile homes and recreational vehicle parks. 3. Determine the regulations for temporary wiring installations. ***VII. Determine the installation requirements for patient care facilities.*** 1. Define related CE Code terms. 2. Determine the requirements for wiring and equipment in patient care areas. 3. Determine the requirements for isolated systems in patient care areas. 4. Determine the requirements for essential electrical systems in patient care areas. ***VIII. Determine CE Code requirements for Class 1 and Class 2 circuits.*** 1. Identify related CE Code terms. 2. Determine the requirements for Class 1 and Class 2 circuits.		
B.	Interpret and apply the electrical STANDATA.		**In Context**
C.	Interpret and apply jurisdictional bylaws, standards, and codes.		**In Context**

Core Competence 4: Electrical Theory, Circuit Fundamentals and Electronics

Weighting – 45%

Electrical theory, circuit fundamentals, and electronics form the foundational knowledge base for electricians, providing the understanding and skills necessary to design, install, and maintain electrical systems. These concepts are essential for electricians to navigate the complexities of electrical work, troubleshoot issues, and ensure the safety and functionality of electrical installations.

This section will focus on single-phase alternating current (AC) circuits that contain capacitors, resistors, and inductors.

CS

Demonstrate knowledge, understanding, and application of electrical theory, circuit fundamentals and electronics.

Core Competence 4: Electrical Theory, Circuit Fundamentals and Electronics

Supporting Competence		Taxonomy	Weighting
4A.	Connect and analyze resistive circuits.		**In Context**
4B.	Connect and analyze single-phase alternating current (AC) circuits. Outcomes for this supporting competence include: ***I. Describe the fundamentals of alternating current (AC).*** 1. Describe the generation of an AC sine wave. 2. Determine the output frequency of an AC generator. 3. Calculate standard AC sine wave values. ***II. Describe the properties of inductors and capacitors.*** 1. Describe an inductor (coil) and its characteristics. 2. Describe induction and its effects. 3. Describe inductance and the factors which affect it. 4. Describe capacitor construction, types, and applications. 5. Describe capacitance and the factors which affect it. ***III. Connect and analyze the effects of capacitors and inductors in circuits.*** 1. Describe the effects of an inductor in a DC circuit. 2. Describe the effects of a capacitor in a DC circuit. 3. Describe the effects of an inductor in an AC circuit. 4. Describe the characteristics of an AC inductive circuit. 5. Calculate inductance and inductive reactance. 6. Describe the effects of a capacitor in an AC circuit. 7. Describe the characteristics of an AC capacitive circuit. 8. Calculate capacitance and capacitive reactance. 9. Connect and analyze pure DC inductive and pure capacitive circuits. 10. Connect and analyze pure AC inductive and pure capacitive circuits. ***IV. State and analyze the characteristics of AC circuits.*** 1. Describe current limiting effects of AC resistance. 2. Describe the factors affecting impedance in an AC Circuit. 3. Recognize and apply formulas being used in electrical theory calculations 4. Perform impedance triangle calculations using Pythagorean theorem and trigonometric functions.	**I, II, III**	**100%**

Core Competence 4: Electrical Theory, Circuit Fundamentals and Electronics

Supporting Competence	Taxonomy	Weighting

5. Describe the relationship between sine waves and phasor diagrams.
6. Perform phasors addition calculations.

V. Calculate power, reactive power and apparent power in AC circuits.

1. Describe the power relationship of an AC resistive circuit.
2. Describe the power relationships in an inductive circuit.
3. Describe the power relationships in a capacitive circuit.
4. Explain the effects of inductance and capacitance in determining reactive power.
5. Calculate the power, apparent power, reactive power, and power factor angle in an AC circuit.
6. Connect and analyze reactive power in an AC circuit.

VI. Connect and analyze AC series circuit containing resistors, inductors, or capacitors.

1. Perform calculations on an AC circuit containing resistors connected in series.
2. Perform calculations on an AC circuit containing inductors connected in series.
3. Perform calculations on an AC circuit containing capacitors connected in series.
4. Connect and analyze AC circuits containing resistors, inductors, or capacitors.

VII. Connect and analyze AC series circuits that contain resistors and inductors and capacitors.

1. Perform calculations on a circuit containing resistor and an inductor connected in series.
2. Perform calculations on a circuit containing resistor and a capacitor connected in series.
3. Connect and analyze circuits containing a resistor and inductor.
4. Connect and analyze circuits containing a resistor and capacitor.
5. Explain the characteristics and applications of a series RLC circuits.
6. Perform calculations on circuits containing a resistor, a coil, and a capacitor connected in series.
7. Connect and analyze AC circuits that contain a resistor, a coil, and capacitors.

VIII. Connect and analyze parallel AC circuits containing resistors, inductors, or capacitors.

1. Perform calculations on an AC circuit containing resistors connected in parallel.
2. Perform calculations on an AC circuit containing inductors connected in parallel.
3. Perform calculations on an AC circuit containing capacitors connected in parallel.
4. Connect and analyze AC circuits that contain resistors connected in parallel.
5. Connect and analyze AC circuits that contain inductors connected in parallel.
6. Connect and analyze AC circuits that contain capacitors connected in parallel.

IX. Connect and analyze AC parallel circuits containing resistors, inductors, and capacitors.

1. Explain the characteristics and applications of a parallel RLC circuit.
2. Perform calculations on a circuit containing resistance, inductive reactance and capacitive reactance connected in parallel.
3. Perform calculations on a circuit containing a heater connected in parallel with a motor.
4. Perform calculations on a circuit containing motors connected in parallel.
5. Connect and analyze AC parallel circuits containing resistors, inductors, and capacitors.

Core Competence 4: Electrical Theory, Circuit Fundamentals and Electronics		
Supporting Competence	**Taxonomy**	**Weighting**
X. ***Analyze single-phase motors.*** 1. Describe the components, principles of operation and applications of a resistance split-phase motor. 2. Describe the components, principle of operation and applications of a two-value capacitor motor. 3. Connect and analyze a dual voltage motor and reverse it. ***XI.*** ***Connect and analyze single-phase power factor correction circuits.*** 1. Describe the reasons and methods of maintaining a high-power factor in an electrical system. 2. Calculate the kVAR rating of a capacitor bank to correct the circuit power factor using the power method. 3. Calculate the kVAR rating of a capacitor bank to correct the circuit power factor using the current method. 4. Connect and analyze single-phase power factor correction circuits.		

Core Competence 5: Electrical Systems

Weighting – 36%

Electrical systems serve as the intricate network of components and wiring that enables the generation, distribution, and utilization of electricity within various structures. For electricians, a comprehensive understanding of electrical systems is paramount, as it forms the basis for their work in designing, installing, and maintaining safe and efficient electrical installations.

This section will focus on heating and cooling systems in addition to magnetic motor controls and switching circuits.

Demonstrate knowledge, understanding and proficiency regarding the preparation, installation, inspection, verification, testing, analysis, troubleshooting, altering, repairing, commissioning, maintaining, operating, and energizing of electrical systems.

Core Competence 5: Electrical Systems		
Supporting Competence	**Taxonomy**	**Weighting**
5A. Identify electrical systems. Outcomes for this supporting competence include: ***I.*** ***Describe heating and cooling systems.*** 1. Describe the principles of heating and cooling. 2. Describe the general types of common heating and cooling systems.	**I**	**18%**

Core Competence 5: Electrical Systems

Supporting Competence	Taxonomy	Weighting
3. Describe the thermostats used in different applications. 4. Describe the operating characteristics of temperature-sensing devices. 5. Describe the purpose and application of a thermocouple. ***II. Describe the components and characteristics of heat trace systems.*** 1. Describe the types of heat trace systems. 2. Describe the controls a heat trace system. 3. Describe the installation of heat trace systems. 4. Describe troubleshooting principles. ***III. Describe the operation of motor protective devices.*** 1. Identify the type of pushbuttons (NO or NC) used for stopping and starting and how they would be connected for multiple station operation. 2. Identify and describe the types of maintained and momentary pilot devices. 3. Describe the operation of automatic pilot devices. 4. Describe overcurrent protection devices. 5. Describe the protection characteristics of fuses and breakers. 6. Identify the factors that determine short circuit currents.		
5B. Install electrical systems. Outcomes for this supporting competence include: ***I. Identify the components and applications of magnetic motor starters and overload protection devices.*** 1. Describe the parts of a magnetic motor starter. 2. Describe the NEMA and IEC numbering system for a motor starter. 3. Describe the criteria for determining the suitability of a starter for a specific application. 4. State the reasons for providing overload devices for motors. 5. Describe the operation and types of overload devices used for motor overload protection. 6. Describe CE Code requirements for ampere rating of control and protective devices in a motor branch circuit. 7. Describe the basic disconnection and control requirements for a motor branch circuit. 8. Describe the source voltage requirement for magnetic motor starters 9. Interpret the ohmmeter readings that determine the operational condition of a starter.	**I, II**	**11%**
5C. Inspect electrical systems.		**In Context**
5D. Verify electrical systems.		**In Context**
5E. Test electrical systems.		**In Context**
5F. Analyze electrical systems. Outcomes for this supporting competence include: ***I. Connect and analyze relays and contactors.*** 1. Describe different types of relays and contactors. 2. Interpret nameplate information. 3. Identify the three main parts of a relay. 4. Describe the purpose of laminations and shading coils in relays and contactors. 5. Identify the applications, advantages and disadvantages of typical materials used for constructing contacts.	**I, II, III**	**33%**

Core Competence 5: Electrical Systems

Supporting Competence	Taxonomy	Weighting

6. Identify the advantages and disadvantages of contact configurations.
7. Describe the operation of relay and contactors.
8. Connect and analyze relay and contactor operation.

II. Analyze timers and smart relays.

1. Describe timers and basic timing functions.
2. Describe smart relays and basic timing functions.
3. Connect and analyze timers and smart relays.

III. Connect and analyze motor control circuits.

1. Identify the three sections of a basic stop/start control circuit.
2. Describe the operation of a control circuit when interlock contacts are placed in each of the three sections.
3. Determine the purpose and connection of indicating lights in a motor control circuit.
4. Differentiate between low voltage release and low voltage protection with practical applications for each of the two types of control circuits.
5. Describe how to troubleshoot a motor control circuit.
6. Connect and analyze the operation of a single station 2-wire control.
7. Connect and analyze the operation of a single station 3-wire control.
8. Connect and analyze the operation of a multiple stop/start stations.

IV. Connect and analyze NEMA and IEC reversing motor starters.

1. Describe the operation of a reversing magnetic motor starter.
2. State the purpose of the mechanical interlocks on a reversing motor magnetic starter.
3. State the purpose of the electrical interlocks on a reversing motor magnetic starter.
4. Describe the NEMA and IEC numbering systems.
5. Identify the sections of the control circuit.
6. Connect and analyze the operation of reversing motor control circuits.
7. Connect and analyze the operation of single station.
8. Connect and analyze the operation of push button interlock.
9. Connect and analyze the operation of limit switches.

5G.	Troubleshoot electrical systems.	**I, II, III**	**38%**

Outcomes for this supporting competence include:

I. Connect and troubleshoot a heating system.

1. Describe the components and operation of a typical electric heating system.
2. Describe the components and operation of a typical 120 V unit heater.
3. Describe the components and operation of a gas-fired furnace.
4. Describe the components and operation of a high-efficient gas-fired furnace.
5. Describe the installation and operation of a fan interlock system on a residential forced-air system.
6. Connect and troubleshoot the operation of heating systems.

II. Connect and troubleshoot cooling systems.

1. Describe the components and operation of a cooling system.
2. Describe the requirements for combining a cooling system with an existing forced-air heating system.
3. Connect and troubleshoot the operation of a cooling system.

III. Connect and troubleshoot control circuits in a commercial HVAC unit.

1. Describe the components of a typical HVAC unit.
2. Describe the operation of a typical HVAC unit.
3. Describe the thermostats used in different applications.
4. Connect and troubleshoot the operation of a roof top HVAC unit.

Core Competence 5: Electrical Systems

Supporting Competence	Taxonomy	Weighting
IV. Connect and troubleshoot control circuits in a hot water heating system. 1. Describe hot water heating systems. 2. Describe the components of a hot water heating system. 3. Connect and troubleshoot the operation of a hot water heating system.		

Period Three
Course Content

(10 weeks – 300 hours)

Period Three Core Competences	Weighting
Foundational Skills, Job Responsibilities and Procedures	**In Context**
Tools, Equipment, and Instruments	**3%**
Codes and Standards	**13%**
Electrical Theory, Circuit Fundamentals and Electronics	**27%**
Electrical Systems	**57%**

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Weighting – In Context

CS

Apply foundational skills essential to convey and receive critical training and workplace information.

Core Competence 2: Tools, Equipment, and Instruments

Weighting – 3%

An Electrician employs a variety of tools, equipment, and instruments throughout their working day. These items extend an individual's ability to perform activities and functions. Tools, equipment, and instruments come in many forms and configurations and require training and knowledge to utilize them in a safe, effective, and intended manner.

This section will focus on knowledge and procedures associated with tools, equipment, and instruments. Components of this section will be integrated and incorporated throughout all periods of the apprenticeship education program.

CS

Demonstrate knowledge, understanding and proficiency regarding the use and maintenance of tools, equipment, and instruments.

Core Competence 2: Tools, Equipment, and Instruments			
Supporting Competence		**Taxonomy**	**Weighting**
2A.	Select, use, and maintain hand tools.		**In Context**
2B.	Select, use, and maintain power tools.		**In Context**
2C.	Select, use, and maintain speciality tools.		**In Context**
2D.	Select, use, and maintain measurement instruments. Outcomes for this supporting competence include: ***I. Connect and analyze equipment used for energy measurement.*** 1. Describe the connection of self-contained meter sockets. 2. Describe the connection and use of instrument transformers. 3. Describe the connection of voltmeter and ammeter transfer switches. 4. Connect and analyze instrument transformers for energy measurement.	***I, II, III***	***100%***
2E.	Select, use, and maintain testing equipment.		**In Context**
2F.	Select, use, and maintain diagnostic equipment.		**In Context**

Core Competence 3: Codes and Standards

Weighting – 13%

Electricians use and apply codes and standards every day in their work environment. Electrical codes and standards are crucial guidelines that govern the design, installation, and maintenance of electrical systems to ensure safety, efficiency, and compliance with regulations. These codes and standards are established to safeguard the well-being of both the public and electrical professionals, maintaining a high standard of electrical work across the province.

This section will focus on motors, transformers, substations, and capacitor banks.

CS

Demonstrate knowledge, understanding and proficiency when interpreting and applying codes and/or standards.

Core Competence 3: Codes and Standards

Supporting Competence	Taxonomy	Weighting
3A. Interpret and apply the CE Code.	**I, II, III**	**100%**

Outcomes for this supporting competence include:

I. Apply the rules and regulations in the CE Code that pertain to grounding and bonding.

1. Define related CE Code terms.
2. Determine grounding and bonding requirements for three-phase systems.
3. Determine grounding requirements for impedance grounded systems.
4. Determine grounding requirements for separately derived systems.

II. Determine protection and control device requirements.

1. Define related CE Code terms.
2. Describe the application and operation of various overcurrent and interrupting devices.
3. Determine the general requirements pertaining to circuit protective devices.
4. Determine when circuit protection and control devices are required.
5. Describe and compare radial and network distribution systems.
6. Determine the requirements for circuit control devices.
7. Describe co-ordination and series rating of overcurrent devices.

III. Determine the installation requirements for capacitors and transformers.

1. Calculate the kVAR rating of capacitors required to improve the power factor of a three-phase inductive load.
2. Select appropriate locations for liquid-filled capacitors and transformers according to CE Code rules.
3. Calculate the rating or setting of the three-phase motor overload device in circuits where power factor correction capacitors are used on the load side of a motor controller.
4. Determine the minimum allowable ampacity of conductors, the rating of disconnect switches and the maximum rating of overcurrent devices for capacitor circuits in a three-phase circuit.
5. Determine the minimum allowable conductor ampacity and the maximum rating of overcurrent devices for transformers.

IV. Determine CE Code requirements for substation and submersible pump installations.

1. Determine the regulations pertaining to the installation of fences guarding electrical equipment and electrical equipment vaults.
2. Determine the regulations pertaining to the installation of switchboards, switchgear, and panel boards.
3. Determine the regulations pertaining to the installation of submersible pumps.

V. Determine the installation requirements for individual motors.

1. Define specific terms and the CE Code general requirements pertaining to the installation of motors.
2. Interpret the CE Code rules pertaining to wiring methods, control, and disconnecting means for motor circuits.
3. Determine the type and ampacity of conductors for individual motors.
4. Determine the maximum ampere rating of overload devices required for motors.
5. Determine the maximum ampere rating for an overcurrent device required for a motor branch circuit.
6. Determine the rating of equipment required to connect an electric motor.

VI. Determine the installation requirements for motor banks.

1. Determine the minimum allowable ampacity and AWG size of feeder conductors required for a group of motors.
2. Determine the maximum ampere rating of the feeder overcurrent device required for a group of motors.
3. Apply the CE Code regulations to connect a group of motors.

Core Competence 3: Codes and Standards			
Supporting Competence		**Taxonomy**	**Weighting**
3B.	Interpret and apply the electrical STANDATA.		**In Context**
3C.	Interpret and apply jurisdictional bylaws, standards, and codes.		**In Context**

Core Competence 4: Electrical Theory, Circuit Fundamentals and Electronics
Weighting – 27%

Electrical theory, circuit fundamentals, and electronics form the foundational knowledge base for electricians, providing the understanding and skills necessary to design, install, and maintain electrical systems. These concepts are essential for electricians to navigate the complexities of electrical work, troubleshoot issues, and ensure the safety and functionality of electrical installations.

This section will focus on three-phase alternating current (AC) systems and connections.

Demonstrate knowledge, understanding, and application of electrical theory, circuit fundamentals and electronics.

Core Competence 4: Electrical Theory, Circuit Fundamentals and Electronics			
Supporting Competence		**Taxonomy**	**Weighting**
4A.	Connect and analyze resistive circuits.		**In Context**
4B.	Connect and analyze single-phase alternating current (AC) circuits.		**In Context**
4C.	Connect and analyze three-phase alternating current (AC) circuits. Outcomes for this supporting competence include: ***I. State the principles of a three-phase electrical system.*** 1. Explain the difference between single-phase power and three-phase power. 2. Explain the generation of the phase voltages of a three-phase system. 3. Explain the phase sequence of three-phase sine waves. 4. State three main advantages of three-phase power over single-phase power. ***II. Connect and analyze three-phase wye systems.*** 1. State the relationship between phase voltage and line voltage for a wye system. 2. State the relationship between phase current and line current for a wye system.	**I, II, III**	**100%**

Core Competence 4: Electrical Theory, Circuit Fundamentals and Electronics

Supporting Competence	Taxonomy	Weighting

3. Explain the importance of a neutral conductor on an unbalanced wye system.
4. Draw a complete phasor diagram of a balanced wye-connected circuit.
5. Draw a phasor diagram of a wye circuit with an unbalanced load.
6. Recognize and apply formulas being used in electrical theory calculations.
7. Perform calculations for a wye-connected circuit.
8. Connect and analyze three-phase wye circuits.

III. Connect and analyze three-phase delta systems.

1. State the relationship between phase voltage and line voltage for a delta system.
2. State the relationship between phase current and line current for a delta system.
3. Draw a complete phasor diagram of a balanced delta connected circuit.
4. Draw a phasor diagram of a delta circuit with an unbalanced load.
5. Perform calculations for a delta connected circuit.
6. Connect and analyze three-phase four-wire delta circuits.
7. Connect and analyze three-phase delta circuits.

IV. Connect and analyze three-phase delta wye systems.

1. Perform calculations for a delta wye-connected circuit.
2. Connect and analyze three-phase delta wye circuits.
3. Connect and analyze three-phase combined delta wye circuits.

V. Calculate the power components of three-phase systems.

1. Calculate the three-phase power components in balanced and unbalanced three-phase systems.
2. Identify the connections for a power quality analyzer in a three-phase circuit.
3. Draw a phasor diagram to determine the power ratings in a three-phase circuit.
4. Connect and analyze a three-phase circuit using a power quality analyzer.

VI. Connect and analyze circuits relating to power factor correction.

1. Define power factor as it applies to a three-phase system.
2. Explain how capacitors will correct the power factor of a circuit.
3. Determine how capacitors should be connected to a three-phase system for power factor correction.
4. Explain how capacitors can be safely connected to and disconnected from a circuit.
5. Perform power factor correction calculations.
6. Connect and analyze power factor correction calculations.

Core Competence 5: Electrical Systems

Weighting – 57%

Electrical systems serve as the intricate network of components and wiring that enables the generation, distribution, and utilization of electricity within various structures. For electricians, a comprehensive understanding of electrical systems is paramount, as it forms the basis for their work in designing, installing, and maintaining safe and efficient electrical installations.

This section will focus on machines, motors, and transformers.

CS	Demonstrate knowledge, understanding and proficiency regarding the preparation, installation, inspection, verification, testing, analysis, troubleshooting, altering, repair, commissioning, maintaining, operating, and energizing of electrical systems.

Core Competence 5: Electrical Systems

Supporting Competence	Taxonomy	Weighting
6A. Identify electrical systems. Outcomes for this supporting competence include: ***I. State the characteristics of three-phase induction motors.*** 1. Identify terms related to a three-phase induction motor. 2. Describe the construction of a three-phase induction motor. 3. Describe the principle of operation of a squirrel cage induction motor. 4. Describe information located on a motor nameplate.	**I**	**11%**
6B. Install electrical systems.		**In Context**
6C. Inspect electrical systems.		**In Context**
6D. Verify electrical systems.		**In Context**
6E. Test electrical systems.		**In Context**
6F. Analyze electrical systems. Outcomes for this supporting competence include: ***I. State the characteristics of single-phase transformers.*** 1. Describe induction and mutual induction in a single-phase transformer. 2. Describe the construction and features of a single-phase transformer. 3. Calculate the ratings, ratios, and associated values of a single-phase transformer. 4. Describe transformer polarities. 5. State how transformer voltage taps are used. 6. Connect and analyze a multiple winding transformer. ***II. Analyze the stator and rotor parameters of three-phase induction motors.*** 1. Calculate synchronous speed and percent slip of a three-phase induction motor. 2. Analyze rotor parameters and their effect on torque. 3. Analyze the effect of load on stator current, rotor parameters, and percent slip. 4. Identify electrical and mechanical characteristics of NEMA rotor designs. 5. Describe the wound rotor motor and its electrical and mechanical characteristics. 6. Determine motor efficiency. ***III. Connect and analyze DC machines.*** 1. Define terms used to describe DC machines. 2. Describe the operation and principles of DC machines. 3. Describe the applications and benefits of DC machines. 4. Connect and analyze DC machines.	**I, II, III**	**64%**

Core Competence 5: Electrical Systems

Supporting Competence	Taxonomy	Weighting
IV. Connect and analyze alternators. 1. Define terms used to describe AC machines. 2. Describe the operation and principles of alternators and generators. 3. Describe the operation of a voltage regulator. 4. Describe how to synchronize and parallel alternators. 5. Describe the method of shifting or sharing load between alternators. 6. Connect and analyze three-phase alternators. 7. Connect and analyze the operation of an automatic voltage regulator. 8. Connect and analyze parallel operation of three-phase alternators. ***V. Connect and analyze synchronous motors.*** 1. Describe the applications of synchronous motors. 2. Compare a synchronous motor to a squirrel cage induction motor. 3. Describe the operation and principles of a synchronous motor. 4. Describe the relationship between excitation and load. 5. Connect and analyze a synchronous motor. ***VI. Connect and analyze single-phase transformers.*** 1. Describe transformer action and calculate percent voltage regulation. 2. Calculate transformer losses. 3. Calculate the efficiency and the available short-circuit current of a transformer. 4. Describe the requirements for paralleling single-phase transformers and associated hazards. 5. Connect and analyze a load test on a transformer. 6. Perform an open-circuit test on a transformer. 7. Perform a short-circuit test on a transformer. 8. Connect and analyze single-phase transformers in parallel. ***VII. Connect and analyze an autotransformer.*** 1. Describe the operation of autotransformers. 2. Perform calculations for an autotransformer. 3. List the advantages and disadvantages of autotransformers. 4. Connect and analyze the operation of an autotransformer. ***VIII. Connect and analyze three-phase transformer connections.*** 1. Describe the characteristics of a wye/wye transformer connection. 2. Describe the characteristics of a delta/delta transformer connection. 3. Describe the characteristics of a wye/delta transformer connection. 4. Describe the characteristics of a delta/four-wire delta transformer connection. 5. Describe the characteristics of a delta/wye transformer connection. 6. Describe the characteristics of an open delta/open delta transformer connection. 7. Describe the characteristics of a Neutral Ground Resistor. 8. Connect and analyze three-phase transformers connections. 9. Connect and analyze an open corner secondary test. 10. Connect and analyze Neutral Ground Resistors.		
6G. Troubleshoot electrical systems. Outcomes for this supporting competence include: ***I. Connect and analyze the operation of three-phase motors and starters.*** 1. Describe the high and low voltage connections of three-phase multi-lead motors. 2. Describe the operation of across the line three-phase motor starters. 3. Describe the operation of wye/delta three-phase motor starters. 4. Describe the operation of autotransformer three-phase motor starters. 5. Identify conditions that could cause the single-phasing of a three-phase motor. 6. Describe the operation of a wound rotor motor.	**I, II, III**	**25%**

Core Competence 5: Electrical Systems

Supporting Competence	Taxonomy	Weighting
7. Connect and identify the leads on a nine-lead motor. 8. Troubleshoot a three-phase motor and starter. ***II. Connect and analyze the operation of variable frequency drives.*** 1. Describe the characteristics of rotary and static phase converters. 2. Describe the applications of variable frequency drives. 3. Describe the considerations for the installation of variable frequency drives. 4. Describe the operation of variable frequency drives. 5. Connect and analyze the operation of a variable frequency drive for various loads. 6. Troubleshoot a three-phase motor and variable frequency drive.		

Period Four
Course Content

(10 weeks – 300 hours)

Period Four Core Competences	Weighting
Foundational Skills, Job Responsibilities and Procedures	**9%**
Tools, Equipment, and Instruments	**In Context**
Codes and Standards	**31%**
Electrical Theory and Circuit Fundamentals	**22%**
Electrical Systems	**38%**

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Weighting – 9%

An Electrician utilizes a host of foundational skills and abilities that will enable them to understand and perform their job responsibilities and apply procedures for everyday activities. These skills are acquired, practiced, and honed through a combination of personal and professional learning environments and are essential tools in the learner's working portfolio.

These supporting competences are observed, studied, and performed in all periods of the apprenticeship education program.

Apply foundational skills essential to convey and receive critical training and workplace information.

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence	Taxonomy	Weighting
1A. Select, use, and maintain personal protective equipment		**In Context**

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence		Taxonomy	Weighting
1B.	Demonstrate safety awareness and safe work practices. Outcomes for this supporting competence include: ***I. Recognize arc flash hazards in electrical installations.*** 1. Identify the hazards associated with arc flash and shock hazards. 2. Describe the requirements of CSA Z462. 3. Describe the personal protective equipment related to arc flash and reference appropriate Z462 tables. 4. Describe lockout procedures related to energized systems. ***II. Describe personal protective grounding.*** 1. Identify the hazards that personal protective grounds guard against. 2. Identify the electrical and mechanical requirements of a personal protective ground. 3. Describe step and touch potential and state how fault current varies with proximity to sources of fault current. 4. Explain the principles of equal-potential bonding and grounding for overhead or underground systems. 5. Explain the procedure for installing and removing personal protective grounds on overhead or underground lines and equipment.	**I**	**38%**
1C.	Demonstrate knowledge and understanding of working at heights.		**In Context**
1D.	Demonstrate knowledge and understanding of material handling.		**In Context**
1E.	Use drawings, diagrams, schematics, and specifications Outcomes for this supporting competence include: ***I. Interpret a motor control circuit.*** 1. Identify symbols used in electrical drawings. 2. State the purpose of the four types of electrical drawings. 3. Demonstrate the ability to interpret schematic diagrams to understand how basic stop/start control and electrical interlock circuits operate in a motor-control circuit. 4. Develop schematic diagrams for control circuits. ***II. Convert between wiring and schematic diagrams.*** 1. Convert diagrams. 2. Determine how the sequence of component connections can affect the wiring installation.	**I, II, III**	**54%**
1F.	Organizes tasks and work area		**In Context**
1G.	Apply quality workmanship practices Outcomes for this supporting competence include: ***I. Use Red Seal products to challenge an Interprovincial examination.*** 1. Identify Red Seal products used to develop Interprovincial examinations. 2. Use Red Seal products to prepare for an Interprovincial examination.	**I**	**4%**
1H.	Demonstrate critical thinking skills.		**In Context**

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence		Taxonomy	Weighting
1I.	Demonstrate numeracy skills.		**In Context**
1J.	Demonstrate literacy skills.		**In Context**
1K.	Demonstrate digital literacy skills.		**In Context**
1L.	Demonstrate communication skills.		**In Context**
1M.	Demonstrate mentorship skills Outcomes for this supporting competence include: ***I. Use coaching skills when training apprentices.*** 1. Describe the process for coaching an apprentice.	**I**	**4%**

Core Competence 2: Tools, Equipment, and Instruments

Weighting – In Context

CS	Demonstrate knowledge, understanding and proficiency regarding the use and maintenance of tools, equipment, and instruments.

Core Competence 3: Codes and Standards

Weighting – 31%

Electricians use and apply codes and standards every day in their work environment. Electrical codes and standards are crucial guidelines that govern the design, installation, and maintenance of electrical systems to ensure safety, efficiency, and compliance with regulations. These codes and standards are established to safeguard the well-being of both the public and electrical professionals, maintaining a high standard of electrical work across the province.

This section will focus on the practical application of codes and standards in electrical installations.

CS	Demonstrate knowledge, understanding and proficiency when interpreting and applying codes and/or standards.

Core Competence 3: Codes and Standards

Supporting Competence	Taxonomy	Weighting
3A. Interpret and apply the CE Code.	**I, II, III**	**100%**

Outcomes for this supporting competence include:

I. Determine the size of conductors.

1. Determine the allowable ampacity and AWG size of circuit conductors.
2. Determine the minimum size of single conductor metal-sheathed cables.
3. Determine the allowable ampacity and AWG size of neutral conductors.
4. Apply the CE Code rules for voltage drop.

II. Apply the grounding and bonding requirements for electrical installations.

1. Apply the CE Code requirements with respect to system and circuit grounding and bonding.
2. Apply the CE Code requirements with respect to equipment bonding.
3. Apply the CE Code requirements with respect to ungrounded systems.
4. Determine the bonding and grounding requirements for an electrical distribution centre.

III. Apply the rules for installation of cables, raceways, and enclosures.

1. Determine the requirements for installation of cables.
2. Determine the requirements for installation and selection of raceway materials.
3. Determine all requirements to allow for conduit expansion including joining of dissimilar materials.
4. Determine the requirements for single conductors in raceways.
5. Determine the minimum dimensions and volume of pull boxes, junction boxes and outlet boxes.
6. Apply the CE Code requirements for an electrical distribution centre.

IV. Determine the installation requirements for communication systems.

1. Describe network cable types and characteristics.
2. Describe typical network cabling system topographies and characteristics.
3. Describe installation requirements for copper network cabling.
4. Describe installation requirements for optical fibre cabling.
5. Explain procedures for testing and troubleshooting network cabling installations.

V. Determine the installation requirements for electric welder.

1. Determine the minimum allowable ampacity of conductors, the maximum rating of overcurrent devices and the rating of the disconnect means for a transformer arc welder.
2. Determine the minimum allowable ampacity of conductors, the maximum rating of overcurrent devices, and the rating of the disconnect means for an electric resistance welder.

VI. Determine the requirements for high-voltage installations.

1. Describe hazards related to high-voltage installations.
2. Identify the components of high-voltage cable and state the purpose of each.
3. Describe the theory of electrical stress control for high-voltage cables.
4. Describe how high-voltage cables are spliced and terminated.
5. Describe the CE Code requirements for high voltage installations.

Core Competence 3: Codes and Standards

Supporting Competence	Taxonomy	Weighting
VII. ***Determine the installation requirements for lighting, emergency systems and unit equipment.*** 1. Describe the different types, components, characteristics, installation and maintenance of electric lighting sources and luminaires. 2. Determine the requirements for the installation of emergency systems and unit equipment. ***VIII.*** ***Determine the classification of hazardous locations.*** 1. Define the specific terms that apply to hazardous locations. 2. Interpret the general section rules regarding installation in hazardous locations. 3. Determine the requirements of an electrical installation in a Zone 0 location. 4. Determine the requirements of an electrical installation in a Zone 1 location. 5. Determine the requirements of an electrical installation in a Zone 2 location. 6. Determine the requirements of an electrical installation in a Zone 20 location. 7. Determine the requirements of an electrical installation in a Zone 21 location. 8. Determine the requirements of an electrical installation in a Zone 22 location. ***IX.*** ***Determine CE Code requirements for flammable gas locations.*** 1. Define related CE Code terms. 2. Determine the requirements for installations in dispensing or refuelling stations for gasoline, propane and natural gas. 3. Determine the requirements for installations in commercial garages. 4. Determine the requirements for installations in bulk storage plants. 5. Determine the requirements for installations in finishing process areas. 6. Determine the requirements for installations in aircraft hangars. ***X.*** ***Determine the installation requirements for Category 1 and 2 locations.*** 1. Define related CE Code terms. 2. Determine the requirements for electrical equipment in Category 1 and Category 2 locations. 3. Determine the requirements for electrical wiring in Category 1 and Category 2 locations. ***XI.*** ***Determine the installation requirement for various electrical applications.*** 1. Determine the installation requirements for branch circuit applications. 2. Determine the installation requirements for motor applications. 3. Determine the installation requirements for service applications. 4. Determine protection and control requirements.		
3B. Interpret and apply the electrical STANDATA.		**In Context**
3C. Interpret and apply jurisdictional bylaws, standards, and codes.		**In Context**

Core Competence 4: Electrical Theory, Circuit Fundamentals and Electronics

Weighting – 22%

Electrical theory, circuit fundamentals, and electronics form the foundational knowledge base for electricians, providing the understanding and skills necessary to design, install, and maintain electrical systems. These concepts are essential for electricians to navigate the complexities of electrical work, troubleshoot issues, and ensure the safety and functionality of electrical installations.

This section will focus on the application of electronics.

CS

Demonstrate knowledge, understanding, and application of electrical theory, circuit fundamentals and electronics.

Core Competence 4: Electrical Theory, Circuit Fundamentals and Electronics

Supporting Competence		Taxonomy	Weighting
4A.	Connect and analyze resistive circuits.		**In Context**
4B.	Connect and analyze single-phase alternating current (AC) circuits.		**In Context**
4C.	Connect and analyze three-phase alternating current (AC) circuits.		**In Context**
4D.	Connect and analyze electronics.	**I, II, III**	**100%**

Outcomes for this supporting competence include:

I. Connect and analyze rectifiers and battery chargers.

1. Describe the different ways of defining voltage and current values.
2. Describe the applications of meters for measuring the electrical characteristics of components and circuits.
3. Describe the operating characteristics of diodes and typical applications of diodes.
4. Describe the principles of operation of single-phase rectifiers.
5. Describe the principles of operation of three-phase rectifiers.
6. Describe the operation of a single-phase battery charger.
7. Recognize and apply formulas being used in electrical theory calculations.
8. Connect and analyze diodes used in rectifier circuits.
9. Troubleshoot the rectifier stage of a battery charger.

II. Connect and analyze rectifiers and filters.

1. Identify types of filters.
2. Describe the effects of adding filters to a rectifier circuit.
3. Describe the operation of a welding machine.
4. Connect and analyze the effects of adding filters to a rectifier circuit.
5. Troubleshoot a filtered rectified circuit.

III. Connect and analyze controlled rectifiers.

1. Describe the principal of operation and application of a Silicone Controlled Rectifier (SCR).
2. Describe the principal of operation and application of SCR triggering circuit.
3. Describe the operation of an SCR in a smoke detector application.
4. Describe the principal of operation and application of a TRIAC.

Core Competence 4: Electrical Theory, Circuit Fundamentals and Electronics

Supporting Competence	Taxonomy	Weighting
5. Describe the operation of an EV charger. 6. Connect and analyze an SCR to control a DC motor from a single-phase-supply. 7. Connect and analyze an SCR to control a DC motor from a three-phase-supply. 8. Connect and analyze a voltage regulator. 9. Connect and analyze a circuit using a TRIAC to control a resistive lighting load. 10. Connect and analyze a circuit using a TRIAC to control motor circuits.		
IV. Connect and analyze circuit harmonics. 1. Describe harmonics. 2. Identify causes of harmonics. 3. Describe consequences of harmonics. 4. Describe methods to manage harmonics. 5. Connect and analyze circuit harmonics.		
V. Connect and analyze an uninterruptible power supply (UPS) system. 1. Describe the principles of operation and applications of a UPS system. 2. Describe the operation of an inverter circuit. 3. Describe the installation of a UPS system. 4. Identify DC arc faults and disconnecting hazards. 5. Connect and analyze a UPS system.		
VI. Program, connect and analyze variable frequency drives. 1. Describe the motor requirements for variable frequency drive (VFD) applications. 2. Describe the principles of operation and application of a VFD. 3. Describe the major components of a VFD. 4. Describe the principles of open-loop, closed-loop, auto-tuning and braking. 5. Program, connect, auto-tune and analyze a VFD.		
VII. State the characteristics of a cathodic protection system. 1. Describe the principles of operation and applications of a cathodic protection system. 2. Describe the operation of a rectifier circuit in a cathodic protection system. 3. Describe the installation of a cathodic protection system and code requirements.		
VIII. Determine the installation requirements for electric renewable energy systems. 1. Describe alternate methods of power generation. 2. Describe the major components, characteristics, and operation of a wind generation system. 3. Describe the major components, characteristics, and operation of a geothermal generation system. 4. Describe the major components, characteristics, and operation of a photovoltaic system. 5. Describe anti-islanding. 6. Calculate the panel board requirements for renewable energy systems. 7. Connect and analyse a renewable energy system.		

Core Competence 5: Electrical Systems

Weighting – 38%

Electrical systems serve as the intricate network of components and wiring that enables the generation, distribution, and utilization of electricity within various structures. For electricians, a comprehensive understanding of electrical systems is paramount, as it forms the basis for their work in designing, installing, and maintaining safe and efficient electrical installations.

This section will focus on building automation and PLCs, hydraulic and pneumatic control systems, and fire alarm systems.

Demonstrate knowledge, understanding and proficiency regarding the preparation, installation, inspection, verification, testing, analysis, troubleshooting, altering, repair, commissioning, maintaining, operating, and energizing of electrical systems.

Core Competence 5: Electrical Systems

Supporting Competence	Taxonomy	Weighting
5A. Identify electrical systems. Outcomes for this supporting competence include: ***I. Identify and describe fire detection and alarm system regulations.*** 1. Describe the areas of jurisdiction of the governing authorities for fire system codes and standards. 2. Determine when a fire alarm system is required for a specific occupancy. ***II. Determine the criteria for the installation of a fire alarm system and for the location of its components.*** 1. Explain the general principles of addressable and non-addressable fire detection alarm systems. 2. Describe active and conventional detection devices. 3. Describe signaling devices and power supplies. 4. Describe ancillary equipment. 5. Explain the operation of a smoke alarm. 6. Determine the type and location of fire alarm components for a specific occupancy. 7. Determine power and emergency power supply requirements for fire alarm systems.	**I, II**	**12%**
5B. Install electrical systems.		**In Context**
5C. Inspect electrical systems.		**In Context**
5D. Verify electrical systems. Outcomes for this supporting competence include: ***I. Verify and maintain fire alarm systems.*** 1. Identify the requirements for the verification, audit, and maintenance of a fire alarm system. 2. Perform a verification inspection.	**I, II**	**4%**

Core Competence 5: Electrical Systems

Supporting Competence		Taxonomy	Weighting
5E.	Test electrical systems.		**In Context**
5F.	Analyze electrical systems.	**I, II, III**	**68%**

Outcomes for this supporting competence include:

I. Design and connect controls and switching circuits.

1. State the sections involved in the forward/reverse/stop control of three-phase motors.
2. Describe jogging and inching circuits.
3. Describe timers and basic timing functions.
4. Explain the operation and application of motor braking.
5. Describe plugging and anti-plugging as it applies to electric motors.
6. Connect and analyze timers and basic timing functions.
7. Connect and analyze three-phase controllers and pilot devices.
8. Connect and analyze three-phase controllers with jogging methods and controls.

II. Program, connect and analyze a PLC.

1. Describe the function of programmable logic controllers.
2. Describe automation control hardware components.
3. Describe discrete and analog circuits.
4. Describe discrete and analog field devices.
5. Describe five types of PLC programming languages.
6. Describe automated building control systems.
7. Program, connect and analyze discrete circuits.
8. Program, connect and analyze analog circuits.
9. Connect and analyze automated building control systems.

III. Connect and analyze pneumatic and hydraulic control systems.

1. Describe pneumatic and hydraulic systems.
2. Describe pneumatic and hydraulic system control components.
3. Explain the purpose of pneumatic and hydraulic system controls.
4. Describe process control systems.
5. Connect and analyze pneumatic and hydraulic system controls.
6. Connect and analyze process control systems.

5G.	Troubleshoot electrical systems.	**I, II, III**	**16%**

Outcomes for this supporting competence include:

I. Connect and troubleshoot fire alarm systems.

1. Determine fire alarm system wiring methods and restrictions as contained in the CE Code.
2. Describe fire alarm circuit designs.
3. Describe fire alarm circuit fault isolation requirements.
4. Determine the number of conductors required in a cable or conduit run at any given location within a fire alarm system.
5. Connect and troubleshoot single stage non-addressable fire alarm systems.
6. Connect and troubleshoot single stage addressable fire alarm systems.
7. Connect and troubleshoot two stage addressable fire alarm systems.

5H.	Alter electrical systems.		**In Context**
5I.	Repair electrical systems.		**In Context**
5J.	Commission electrical systems.		**In Context**

Core Competence 5: Electrical Systems

Supporting Competence		Taxonomy	Weighting
5K.	Maintain electrical systems.		**In Context**
5L.	Operate electrical systems.		**In Context**
5M.	Energize electrical systems.		**In Context**

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