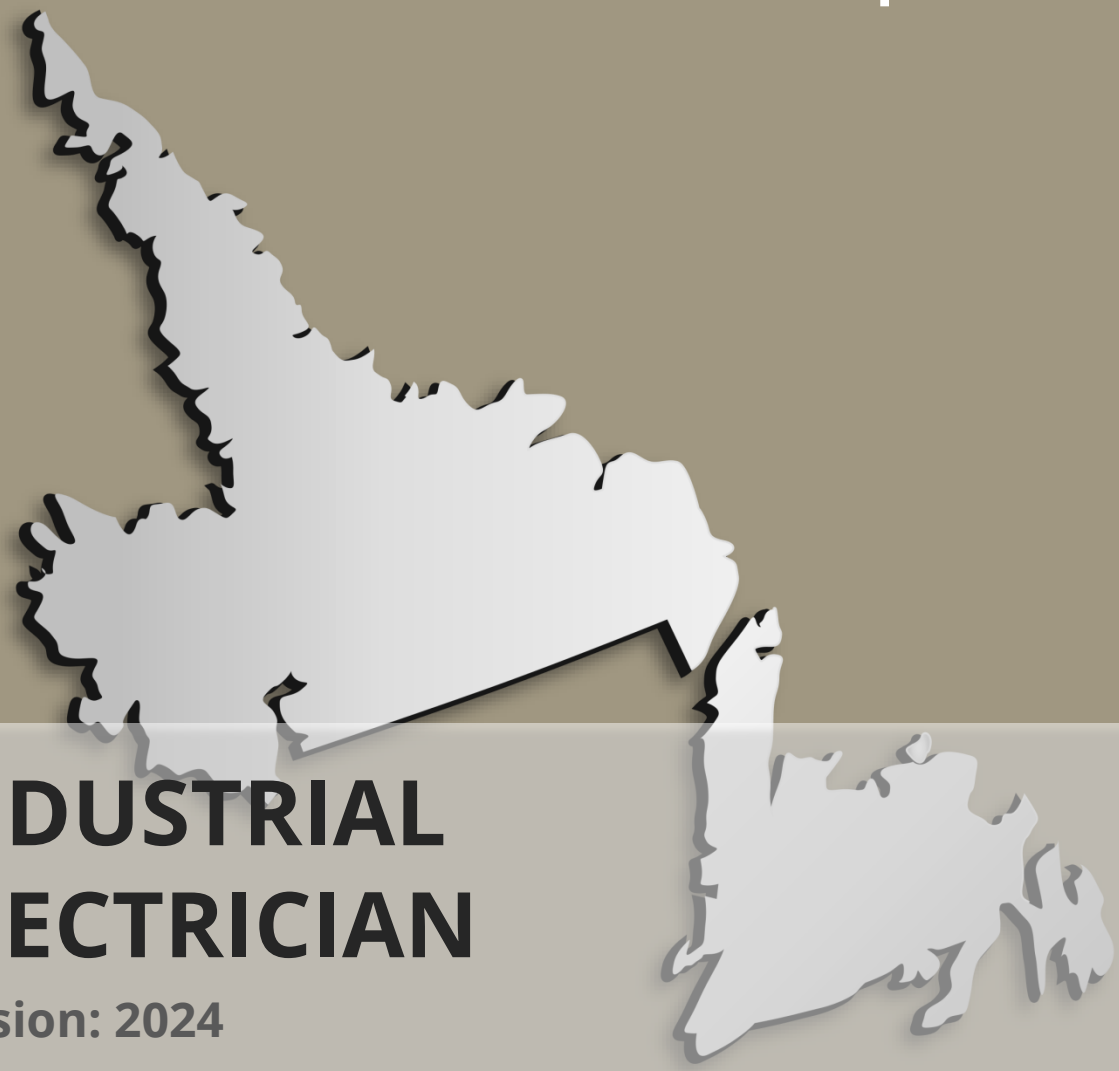
Atlantic Workforce Partnership

Curriculum Standard



INDUSTRIAL ELECTRICIAN

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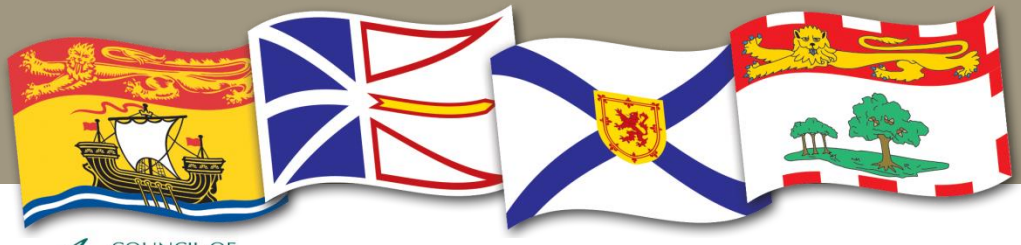
Atlantic Apprenticeship



COUNCIL OF ATLANTIC PREMIERS
CONSEIL DES PREMIERS MINISTRES DE L'ATLANTIQUE

Employment and Social Development Canada
Emploi et Développement social Canada

Preface

This Atlantic Apprenticeship Curriculum Standard is intended to assist instructional staff in the design and delivery of technical, in-class training in support of the Industrial Electrician programs.

This document contains all the technical training elements required to complete the Industrial Electrician apprenticeship programs and has been developed based on the 2021 Red Seal Occupational Standards (RSOS). The RSOS documents can be found on the Red Seal website (www.red-seal.ca).

Implementation of this AACS for Apprenticeship training is outlined in the following table.

Level	**Implementation Effective**
Level 1	2025-2026
Level 2	2026-2027
Level 3	2027-2028
Level 4	2028-2029

The above implementation schedule was current at time of printing. Please confirm with Apprenticeship Staff prior to commencing training.

Granting of credit or permission to challenge level examinations for pre-employment or pre-apprenticeship training for the Industrial Electrician trades will be based on the content outlined in this standard. Training providers must contact their provincial apprenticeship authority for more information on the process and requirements for determining eligibility for credit towards an apprenticeship program.

Acknowledgements

The development of the Atlantic Apprenticeship Curriculum Standard (AACS) is an initiative of the Atlantic Apprenticeship Council's Atlantic Apprenticeship Harmonization Project (AAHP) through the Atlantic Workforce Partnership.

The AAHP was created in 2014 and funded through contributions from Employment and Social Development Canada (ESDC) and the four Atlantic Provinces. In 2023, Phase III of the AAHP concluded and the AAHP transitioned to a maintenance office supported by the four Atlantic Provinces. The Atlantic Apprenticeship Council would like to thank ESDC for the financial support provided to harmonize the 23 trades in Phase I, II and III of the AAHP.

Advisory committees, industry representatives, instructors and apprenticeship staff provided valuable input to the development of the trade Atlantic Apprenticeship Curriculum Standard (AACS) in 2017 and updating of the trade AACS in 2024. Without their dedication to quality apprenticeship training, this document could not have been produced. The Atlantic Apprenticeship Council wishes to acknowledge the contributions of the industry and instructional representatives who participated in the development of this document.

Table of Contents

User Guide

Atlantic Apprenticeship Curriculum Standards (AACS) are developed based on trade specific national occupational standards, such as the Red Seal Occupational Standard (RSOS), and industry consultation. This document represents the minimum content to be delivered as part of the harmonized Atlantic program for the Bricklayer trade.

The AACSs are deliberately constructed for ease of use and flexibility of structure to adapt to all delivery requirements. They detail units of training, unit outcomes and objectives. They do not impose a delivery model or teaching format.

Jurisdictions and/or training providers will select and develop delivery materials and techniques that accommodate a variety of learning styles and delivery patterns. The AACS does not dictate study materials, textbooks or learning activities to be used in delivery.

The document includes a Level Structure to facilitate mobility for apprentices moving from one jurisdiction to another.

Structure

The content of the AACS is divided into units. Unit codes are used as a means of identification and are not intended to convey the order of delivery. It is at the discretion of the training provider to deliver the content in the required logical sequence of delivery within the level. Jurisdictions are free to deliver units one at a time or concurrently within a level, provided all outcomes are met.

The Learning Outcomes describe what the apprentice should know or be able to do at the end of training. Wording of the Learning Outcomes, “Demonstrate knowledge of…” acknowledges the broad spectrum of ways in which knowledge can be assessed (i.e., practical projects, multiple choice testing, presentations, etc.) by instructional staff within the training.

Summative evaluation will be through a multiple-choice level exam administered through the jurisdictional Apprenticeship Authority.

User Guide (continued)

The Red Seal Occupational Standard (RSOS) to AACS comparison chart outlines the relation between each RSOS sub-task and the AACS units. RSOS references have also been detailed in each unit to highlight the direct link between the unit and relevant sub-tasks in the RSOS.

In the Level Structure section, the document identifies suggested hours to provide an indication of the time it should take to cover the material in the unit and is provided as a guide only. Adjustments to the suggested hours for each unit may be required to account for rate of apprentice learning, statutory holidays, storm days, registration, and examinations. These suggested hours detailed for each unit will represent both theory and practical training (if relevant) and for consistency will be based on a standard of 30 hours per week of training. The true length of time required to deliver an outcome successfully will depend upon the learning activities and teaching methods used.

There are two types of objectives found in the AACS document: theoretical and practical.

The theoretical objectives represent the material that is to be covered during the technical training to convey the required knowledge to the apprentice.

The practical objectives represent the tasks or skills that have been deemed by the Atlantic Trade Advisory Committee as critical for the apprentices to receive exposure to while attending technical training. For example, exposure could be done through instructor demonstration or individual or group performance of the skill or task. Training providers are encouraged to use practical demonstration and opportunities for hands-on learning whenever possible. Practical objectives are not intended to replace the on-the-job training component of the apprentice's program or to mirror or replace the logbook skills that are to be taught and evaluated in the workplace.

Detailed content for each objective has not been developed. Where detail is required for clarity, content has been provided. The AACS should be used in conjunction with the national standard for the trade – the Red Seal Occupational Standard (RSOS).

Glossary of Terms

These definitions are intended as a guide to how language is used in the document.

Adjust	To put in good working order; regulate; bring to a proper state or position.
Application	The use to which something is put and/or the circumstance in which an individual would use it.
Characteristic	A feature that helps to identify, tell apart or describe recognizably, a distinguishing mark or trait.
Component	A part that can be separated from or attached to a system, a segment or unit.
Define	To state the meaning of (a word, phrase, etc.).
Describe	To give a verbal account of; talk about in detail.
Explain	To make plain or clear; illustrate; rationalize.
Identify	To point out or name objectives or types.
Interpret	To translate information from observation, charts, tables, graphs, and written material.
Maintain	To keep in a condition of good repair or efficiency.
Method	A means or manner of doing something that has procedures attached to it.
Operate	How an object works; to control or direct the functioning of.
Procedure	A prescribed series of steps taken to accomplish an end.
Purpose	The reason for which something exists or is done, made or used.

Glossary of Terms (continued)

Service	Routine inspection and replacement of worn or deteriorating parts. An act or business function provided to a customer in the course of an individual's profession (e.g., haircut).
Technique	Within a procedure, the manner in which technical skills are applied.
Test	v. To subject to a procedure that ascertains effectiveness, value, proper function, or other quality. n. A way of examining something to determine its characteristics or properties, or to determine whether it is working correctly.

Essential Skills Profiles/Skills for Success

Through extensive research, the Government of Canada and other national and international agencies have identified and validated key essential skills for the workplace. These skills are used in nearly every job and at different levels of complexity. They provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change. In response to the evolving labour market and changing skill needs, in 2021 the Government of Canada launched a new **Skills for Success** model: QR code #1 or web link below.

https://www.canada.ca/en/services/jobs/training/initiatives/skills-success/new-model.html

The Employment and Social Development Canada (ESDC) website provides information about the Skills for Success, including:

- a brief description of the skill;
- why the skill is important;
- tools to help you improve on each of the skills, and
- Videos to help you improve on each of the skills.

This information can be found at: QR code #2 or web link below.
https://www.jobbank.gc.ca/essentialskills

Skills for Success training tools can be found at: QR code #3 or web link below.
https://www.canada.ca/en/services/jobs/training/initiatives/skills-success/tools.html

The development and improvement of these Skills for Success is inherent throughout the apprenticeship training program as apprentices work towards achieving journeyperson status.

#1 The new Skills for Success model – Canada.ca

#2 Explore careers by essential skills – Job Bank

#3 Assessment and training tools – Canada.ca

Level Structure

Level 1 – 10 Weeks

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
ELE-100	Safety	6	22	N/A
ELE-105	Tools and Equipment	6	25	N/A
ELE-110	Access Equipment	6	26	N/A
ELE-115	Hoisting, Lifting and Rigging	6	27	1. Tie common knots.
ELE-120	Support Components	6	29	N/A
ELE-125	Trade Documentation	6	31	N/A
MENT-700	Mentoring I	6	32	N/A
ELE-135	Drawings, Schematics and Specs I	12	34	N/A
ELE-140	Worksite Preparation & Organization	6	36	N/A
ELE-145	DC Theory	30	38	1. Use instruments to troubleshoot DC components. i) closed circuit ii) open circuit
ELE-150	DC Circuits	30	40	1. Use instruments to troubleshoot series, parallel and complex DC circuits.
ELE-155	Single-Phase AC Theory	18	41	N/A
ELE-160	Single-Phase AC Circuits I	30	43	1. Use electrical instruments to troubleshoot series & parallel AC circuits.
ELE-165	Intro to the Canadian Electrical Code	6	45	1. Locate & interpret information in the CEC.
ELE-170	Grounding and Bonding Systems I	6	46	N/A
ELE-175	Single-Phase Services	18	48	1. Install a single-phase service.
ELE-180	Single-Phase Power Distribution Equip.	18	50	N/A
ELE-185	Conductors and Cables	18	52	1. Install, splice & terminate conductors & cables.
ELE-190	Conduit, Tubing and Fittings	12	54	1. Cut and bend conduit and tubing.
ELE-195	Raceways	6	56	N/A
ELE-196	Boxes and Enclosures	12	58	N/A
ELE-197	Wiring Devices	6	60	N/A
ELE-198	Luminaires and Lighting Controls	24	62	1. Install a luminaire and lighting controls with operation from multiple locations.
ELE-199	Introduction to Communication Systems	6	65	N/A

Level 2 – 9 Weeks

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
ELE-220	Job Planning	6	68	N/A
ELE-225	Voltage Drop and Power Loss	30	69	N/A
ELE-230	Enviro & Hazardous Installations	24	70	N/A
ELE-235	DC Generating & Conversion Systems	15	72	N/A
ELE-240	Single-Phase AC Circuits II	27	74	N/A
ELE-245	Protection Devices	24	76	N/A
ELE-250	Extra-Low Voltage Transformers	6	79	N/A
ELE-255	Low-Voltage Single-Phase Transformers	12	81	N/A
ELE-260	Renewable Energy & Storage Sys I	9	83	N/A
ELE-265	Exit and Emergency Lighting Systems	12	85	N/A
ELE-270	Heating, Ventilation and A/C Sys.	15	87	N/A
ELE-275	Heating, Ventilation & A/C Sys. Controls	12	89	N/A
ELE-280	Electric Heating Systems	12	91	N/A
ELE-285	Electric Heating System Controls	12	93	N/A
ELE-290	Cathodic Protection Systems	6	95	N/A
ELE-295	DC Motors I	12	97	N/A
ELE-296	Motor Starters I	6	99	N/A
ELE-297	Motor Control Devices I	12	101	N/A
ELE-298	Drawings, Schematics & Specs II	12	103	N/A
ELE-299	Lightning Protection Systems	6	104	N/A

Level 3 – 8 Weeks

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
ELE-320	Three-Phase Theory	30	108	N/A
ELE-325	Ground Fault Protection and Detection Systems I	12	110	N/A
ELE-330	Three-Phase Services	12	112	N/A
ELE-335	Three-Phase Power Distribution Equip.	18	114	N/A
ELE-340	AC Generating Systems	18	116	N/A
ELE-345	Low-Voltage Three-Phase Transformers	18	118	1. Install, connect and test a low-voltage three-phase transformer.
ELE-350	High-Voltage Transformers	12	121	N/A
ELE-355	Motor Starters II	18	123	N/A
ELE-360	Motor Control Devices II	24	125	1. Connect & operate control circuits.

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
ELE-365	Single-Phase Motors I	18	127	1. Connect & operate single-phase motors.
ELE-370	Three-Phase Motors I	18	129	1. Connect & operate three-phase motors.
ELE-375	DC Motors II	12	131	1. Connect & operate DC motors.
ELE-380	AC Drives	18	132	1. Connect, adjust & operate AC drives.
ELE-385	DC Drives	12	134	N/A

Level 4 Industrial – 12 Weeks

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
MENT-701	Mentoring II	6	138	N/A
IEL-405	Ground Fault Protection and Detection Systems II	3	139	N/A
IEL-410	Power Conditioning, Uninterruptible Power Supply (UPS) & Surge Suppression Systems	18	140	N/A
IEL-415	High-Voltage Equipment	18	142	N/A
IEL-420	High-Voltage Cables	12	145	N/A
IEL-425	Renewable Energy and Storage Systems II	12	147	N/A
IEL-430	Single-Phase Motors II	6	150	N/A
IEL-435	DC Motors III	6	151	N/A
IEL-440	Three-Phase Motors II	9	152	N/A
IEL-445	Commissioning & Decommissioning	18	153	N/A
IEL-450	Fire Alarm Systems	12	155	N/A
IEL-455	Security and Surveillance Systems	6	158	N/A
IEL-460	Communication Sys (Voice/Data/ Video & Closed-Circuit Television)	6	160	N/A
IEL-465	Communication Systems (Public Address and Intercom Systems)	6	162	N/A
IEL-470	Communication Systems (Nurse Call Systems)	6	164	N/A
IEL-475	Building Automation & Control Sys	12	166	N/A
IEL-480	Predictive/Preventative Maintenance	12	169	N/A
IEL-485	Automated Control Systems	60	171	1. Design, program & execute a program for a PLC.
IEL-490	Pneumatic Control Systems	18	174	N/A
IEL-491	Hydraulic Systems & Control Devices	12	176	N/A
IEL-492	Discrete and Analog Devices	30	178	1. Install and calibrate an analog device.
IEL-493	Process Control	30	181	1. Set up a control loop.
IEL-494	Other Fixed Equipment and Controls	12	183	N/A
IEL-495	Program Review	30	185	N/A

***Suggested Hours:** The time it should take to cover the unit (a guide only).
***Practical Objectives:** The tasks/skills apprentices must be exposed to during technical training. An individual or group performance of the task/skill is recommended; if not possible, an instructor demonstration is acceptable. Training Providers should use practical, hands-on learning whenever possible, whether identified in the curriculum as a practical objective or not.

2021 RSOS Sub-Task to AACS Unit Comparison

RSOS Sub-Task		AACS Unit	
Task 1 – Performs safety-related functions.			
1.01	Maintains safe work environment.	ELE-100	Safety
		ELE-230	Environmental and Hazardous Installations
1.02	Uses personal protective equipment (PPE) and safety equipment.	ELE-100	Safety
1.03	Performs lock-out and tag-out procedures.	ELE-100	Safety
1.04	Identifies environmental conditions.	ELE -230	Environmental and Hazardous Installations
Task 2 – Uses tools and equipment.			
2.01	Uses common and specialty tools and equipment.	ELE-105	Tools and Equipment
2.02	Uses access equipment.	ELE-110	Access Equipment
2.03	Uses rigging, hoisting and lifting equipment.	ELE-115	Hoisting, Lifting and Rigging
Task 3 – Organizes work.			
3.01	Interprets plans, drawings and specifications.	ELE-135	Drawings, Schematics and Specifications I
		ELE-298	Drawings, Schematics and Specifications II
3.02	Identifies hazardous locations.	ELE-100	Safety
		ELE -230	Environmental and Hazardous Installations
3.03	Organizes materials and supplies.	ELE-140	Worksite Preparation and Organization
3.04	Plans project tasks and procedures.	ELE-140	Worksite Preparation and Organization
		ELE-220	Job Planning
3.05	Prepares specific location in facility.	ELE-140	Worksite Preparation and Organization
		ELE-230	Environmental and Hazardous Installations
3.06	Finalizes required documentation.	ELE-125	Trade Documentation
Task 4 – Fabricates and installs support components.			
4.01	Fabricates support structures.	ELE-120	Support Components

RSOS Sub-Task		AACS Unit	
4.02	Installs brackets, hangers and fasteners.	ELE-120	Support Components
4.03	Installs seismic restraint systems.	ELE-120	Support Components
Task 5 – Commissions and decommissions electrical systems.			
5.01	Commissions systems.	ELE-175	Single-Phase Services
		ELE-180	Single-Phase Power Distribution Equipment
		ELE-445	Commissioning and Decommissioning
5.02	Performs shutdown and startup procedures.	ELE-175	Single-Phase Services
		ELE-180	Single-Phase Power Distribution Equipment
		ELE-445	Commissioning and Decommissioning
5.03	Decommissions systems.	ELE- 175	Single-Phase Services
		ELE-180	Single-Phase Power Distribution Equipment
		ELE-445	Commissioning and Decommissioning
Task 6 – Uses communication and mentoring techniques.			
6.01	Uses communication techniques.	MENT-700	Mentoring I
		MENT-701	Mentoring II
6.02	Uses mentoring techniques.	MENT-700	Mentoring I
		MENT-701	Mentoring II
Task 7 – Installs and maintains utility and non-utility supply services and metering equipment.			
7.01	Installs single-phase utility and non-utility supply services and metering equipment.	ELE-175	Single-Phase Services
7.02	Maintains single-phase utility and non-utility supply services and metering equipment.	ELE-175	Single-Phase Services
7.03	Installs three-phase utility and non-utility supply services and metering equipment.	ELE-330	Three-Phase Services

RSOS Sub-Task		AACS Unit	
7.04	Maintains three-phase utility and non-utility supply services and metering equipment.	ELE-330	Three-Phase Services
Task 8 – Installs and maintains protection devices.			
8.01	Installs overcurrent protection devices.	ELE-175	Single-Phase Services
		ELE-245	Protection Devices
8.02	Maintains overcurrent protection devices.	ELE-175	Single-Phase Services
		ELE-245	Protection Devices
8.03	Installs ground fault, arc fault and surge protection devices.	ELE-175	Single-Phase Services
		ELE-245	Protection Devices
		ELE-299	Lightning Protection Devices
8.04	Maintains ground fault, arc fault and surge protection devices.	ELE-175	Single-Phase Services
		ELE-245	Protection Devices
8.05	Installs under- and over-voltage protection devices.	ELE-180	Single-Phase Power Distribution Equipment
		ELE-245	Protection Devices
8.06	Maintains under- and over-voltage protection devices.	ELE-180	Single-Phase Power Distribution Equipment
		ELE-245	Protection Devices
Task 9 – Installs and maintains low-voltage distribution systems.			
9.01	Installs low-voltage distribution equipment.	ELE-180	Single-Phase Power Distribution Equipment
		ELE-335	Three-Phase Power Distribution Equipment
9.02	Maintains low-voltage distribution equipment.	ELE-180	Single-Phase Power Distribution Equipment
		ELE-335	Three-Phase Power Distribution Equipment
Task 10 – Installs and maintains power conditioning systems.			
10.01	Installs power conditioning systems.	IEL-410	Power Conditioning, Uninterruptible Power Supply (UPS) and Surge Suppression Systems
10.02	Maintains power conditioning systems.	IEL-410	Power Conditioning, Uninterruptible Power Supply (UPS) and Surge Suppression Systems
Task 11 – Installs and maintains bonding and grounding, and ground-fault protection and detection systems.			
11.01	Installs grounding systems.	ELE-170	Grounding and Bonding Systems I

RSOS Sub-Task		AACS Unit	
		ELE-235	DC Generating and Conversion Systems
		ELE-340	AC Generating Systems
11.02	Maintains grounding systems.	ELE-170	Grounding and Bonding Systems I
11.03	Installs bonding systems.	ELE-170	Grounding and Bonding Systems I
		ELE-235	DC Generating and Conversion Systems
		ELE-340	AC Generating Systems
11.04	Maintains bonding systems.	ELE-170	Grounding and Bonding Systems I
11.05	Installs ground-fault protection and detection systems.	ELE-325	Ground Fault Protection and Detection Systems I
11.06	Maintains ground-fault protection and detection systems.	ELE-245	Protection Devices
		IEL-405	Ground Fault Protection and Detection Systems II
Task 12 – Installs and maintains power generation and conversion systems.			
12.01	Installs alternating current (AC) generating systems.	ELE-340	AC Generating Systems
12.02	Maintains AC generating systems.	ELE-340	AC Generating Systems
12.03	Installs direct current (DC) generating and conversion systems.	ELE-235	DC Generating and Conversion Systems
12.04	Maintains DC generating and conversion systems.	ELE-235	DC Generating and Conversion Systems
Task 13 – Installs and maintains renewable energy generating and energy storage systems.			
13.01	Installs renewable energy generating and energy storage systems.	ELE-260	Renewable Energy and Storage Systems I
		IEL-425	Renewable Energy and Storage Systems II
13.02	Maintains renewable energy generating and energy storage systems.	IEL-425	Renewable Energy and Storage Systems II
Task 14 – Installs and maintains high-voltage systems.			
14.01	Installs high-voltage systems.	IEL-415	High-Voltage Equipment
		IEL-420	High-Voltage Cables
14.02	Maintains high-voltage systems.	IEL-415	High-Voltage Equipment
		IEL-420	High-Voltage Cables
Task 15 – Installs and maintains transformers.			
15.01	Installs extra-low voltage transformers.	ELE-250	Extra-Low Voltage Transformers

RSOS Sub-Task		AACS Unit	
15.02	Maintains extra-low voltage transformers.	ELE-250	Extra-Low Voltage Transformers
15.03	Installs low-voltage single-phase transformers.	ELE-255	Low-Voltage Single-Phase Transformers
15.04	Maintains low-voltage single-phase transformers.	ELE-255	Low-Voltage Single-Phase Transformers
15.05	Installs low-voltage three-phase transformers.	ELE-345	Low-Voltage Three-Phase Transformers
15.06	Maintains low-voltage three-phase transformers.	ELE-345	Low-Voltage Three-Phase Transformers
15.07	Installs high-voltage transformers.	ELE-350	High-Voltage Transformers
15.08	Maintains high-voltage transformers.	ELE-350	High-Voltage Transformers
Task 16 – Installs and maintains raceways, cables, conductors and enclosures.			
16.01	Installs conductors and cables.	ELE-185	Conductors and Cables
		ELE-230	Environmental and Hazardous Installations
16.02	Maintains conductors and cables.	ELE-185	Conductors and Cables
		ELE-230	Environmental and Hazardous Installations
16.03	Installs conduit, tubing and fittings.	ELE-190	Conduit, Tubing and Fittings
		ELE-230	Environmental and Hazardous Installations
16.04	Installs raceways.	ELE-195	Raceways
		ELE-230	Environmental and Hazardous Installations
16.05	Installs boxes and enclosures.	ELE-196	Boxes and Enclosures
		ELE-230	Environmental and Hazardous Installations
16.06	Maintains conduit, tubing, fittings raceways, boxes and enclosures.	ELE-190	Conduit, Tubing and Fittings
		ELE-195	Raceways
		ELE-196	Boxes and Enclosures
		ELE-230	Environmental and Hazardous Locations
Task 17 – Installs and maintains branch circuitry and devices.			
17.01	Installs luminaires.	ELE-198	Luminaires and Lighting Controls
17.02	Maintains luminaires.	ELE-198	Luminaires and Lighting Controls
17.03	Installs wiring devices.	ELE-197	Wiring Devices
17.04	Maintains wiring devices.	ELE-197	Wiring Devices

RSOS Sub-Task		AACS Unit	
Task 18 – Installs and maintains heating, ventilating and air-conditioning (HVAC) electrical components.			
18.01	Connects power to HVAC systems and associated equipment.	ELE-270	Heating, Ventilation and Air-Conditioning Systems
18.02	Installs HVAC controls.	ELE-275	Heating, Ventilation and Air-Conditioning System Controls
18.03	Maintains HVAC electrical components.	ELE-270	Heating, Ventilation and Air-Conditioning Systems
		ELE-275	Heating, Ventilation and Air-Conditioning System Controls
Task 19 – Installs and maintains electric heating systems and controls.			
19.01	Installs electric heating systems and controls.	ELE-280	Electric Heating Systems
		ELE-285	Electric Heating System Controls
19.02	Maintains electric heating systems and controls.	ELE-280	Electric Heating Systems
		ELE-285	Electric Heating System Controls
Task 20 – Installs and maintains exit and emergency lighting systems.			
20.01	Installs exit and emergency lighting systems.	ELE-265	Exit and Emergency Lighting Systems
20.02	Maintains exit and emergency lighting systems.	ELE-265	Exit and Emergency Lighting Systems
Task 21 – Installs and maintains cathodic protection systems.			
21.01	Installs cathodic protection systems.	ELE-290	Cathodic Protection Systems
21.02	Maintains cathodic protection systems.	ELE-290	Cathodic Protection Systems
Task 22 – Installs and maintains motor starters and control devices.			
22.01	Installs motor starters.	ELE-296	Motor Starters I
		ELE-355	Motor Starters II
22.02	Maintains motor starters.	ELE-296	Motor Starters I
		ELE-355	Motor Starters II
22.03	Installs motor control devices.	ELE-297	Motor Control Devices I
		ELE-355	Motors Starters II
22.04	Maintains motor control devices.	ELE-297	Motors Control Devices I
		ELE-360	Motors Control Devices II
Task 23 – Installs and maintains drives.			
23.01	Installs alternating current (AC) drives.	ELE-380	AC Drives

RSOS Sub-Task		AACS Unit	
23.02	Maintains alternating current (AC) drives.	ELE-380	AC Drives
23.03	Installs direct current (DC) drives.	ELE-385	DC Drives
23.04	Maintains direct current (DC) drives.	ELE-385	DC Drives
Task 24 – Installs and maintains other fixed equipment and associated controls.			
24.01	Installs other fixed equipment and associated controls.	IEL-494	Other Fixed Equipment and Controls
24.02	Maintains other fixed equipment and associated controls.	IEL-494	Other Fixed Equipment and Controls
Task 25 – Installs and maintains motors.			
25.01	Installs single-phase motors.	ELE-365	Single-Phase Motors I
25.02	Maintains single-phase motors.	IEL-430	Single-Phase Motors II
25.03	Installs three-phase motors.	ELE-370	Three-Phase Motors I
25.04	Maintains three-phase motors.	IEL-440	Three-Phase Motors II
25.05	Installs direct current (DC) motors.	ELE-295	DC Motors I
		ELE-375	DC Motors II
25.06	Maintains direct current (DC) motors.	ELE-295	DC Motors I
		IEL-435	DC Motors III
Task 26 – Installs and maintains signaling systems.			
26.01	Installs fire alarm systems.	IEL-450	Fire Alarm Systems
26.02	Maintains fire alarm systems.	IEL-450	Fire Alarm Systems
26.03	Installs security and surveillance systems.	IEL-455	Security and Surveillance Systems
26.04	Maintains security and surveillance systems.	IEL-455	Security and Surveillance Systems
Task 27 – Installs and maintains communication systems.			
27.01	Installs communication systems.	ELE-199	Introduction to Communication Systems
		IEL-460	Communication Systems (Voice/Data/Video and Closed-Circuit Television)
		IEL-465	Communication Systems (Public Address and Intercom Systems)
		IEL-470	Communication Systems (Nurse Call Systems)
27.02	Maintains communication systems.	IEL-460	Communication Systems (Voice/Data/Video and Closed-Circuit Television)

RSOS Sub-Task		AACS Unit	
		IEL-465	Communication Systems (Public Address and Intercom Systems)
		IEL-470	Communication Systems (Nurse Call Systems)
Task 28 – Installs and maintains building automation systems.			
28.01	Installs building automation systems.	IEL-475	Building Automation and Control Systems
28.02	Maintains building automation systems.	IEL-475	Building Automation and Control Systems
Task 29 – Installs and maintains process control systems.			
29.01	Installs discrete input/output (I/O) devices.	IEL-492	Discrete and Analog Devices
29.02	Maintains discrete input/output (I/O) devices.	IEL-492	Discrete and Analog Devices
29.03	Installs analog input/output (I/O) devices.	IEL-492	Discrete and Analog Devices
29.04	Maintains analog input/output (I/O) devices.	IEL-492	Discrete and Analog Devices
Task 30 – Installs, programs and maintains automated control systems.			
30.01	Installs automated control systems.	IEL-485	Automated Control Systems
30.02	Maintains automated control systems.	IEL-485	Automated Control Systems
		IEL-493	Process Control
30.03	Programs automated control systems.	IEL-485	Automated Control Systems
30.04	Optimizes system performance.	IEL-485	Automated Control Systems
		IEL-493	Process Control
Task 31 – Installs and maintains pneumatic and hydraulic control systems.			
31.01	Installs pneumatic control systems.	IEL-490	Pneumatic Control Systems
31.02	Maintains pneumatic control systems.	IEL-490	Pneumatic Control Systems
31.03	Installs hydraulic control systems.	IEL-491	Hydraulic Systems and Control Devices
31.04	Maintains hydraulic control systems.	IEL-491	Hydraulic Systems and Control Devices

Level 1

ELE-100 Safety

Learning Outcomes:

- Demonstrate knowledge of personal protective equipment (PPE) and safety equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of safe work practices.
- Demonstrate knowledge of regulatory requirements pertaining to safety, PPE and safety equipment.
- Demonstrate knowledge of procedures to lock-out and tag-out equipment.
- Demonstrate knowledge of safety checks of equipment.
- Demonstrate knowledge of procedures for voltage testing.

IEL 2021 Red Seal Occupational Standard Reference:

1.01 Maintains safe work environment.
1.02 Uses personal protective equipment (PPE) and safety equipment.
1.03 Performs lock-out and tag-out procedures.
3.02 Identifies hazardous installation. (Introduction)

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Identify hazards and briefly describe safe work practices.
   - i) arc flashes/blasts
   - ii) liquid spills (flammable, corrosive, toxic)
   - iii) electric shocks
   - iv) combustible dust
   - v) ionizing radiation (including ultraviolet C)
   - vi) open holes
   - vii) confined space
   - viii) fire
   - ix) tripping hazards
   - x) overhead work
   - xi) working at heights
   - xii) hazardous locations

2. Identify and interpret workplace health and safety regulations pertaining to safety, PPE and safety equipment.
   - i) occupational health and safety (OHS)
   - ii) fall protection

iii) confined spaces
iv) workplace hazardous materials information system (WHMIS)
v) safety data sheets (SDS)/globally harmonized system of classification and labelling of chemicals (GHS)

3. Identify and interpret the regulatory requirements pertaining to hazards and emergency situations.
   i) hazards
   ii) emergency situations

4. Identify types of personal protective equipment (PPE) and safety equipment and describe their applications, limitations and procedures for use.
   i) PPE
      - shock hazard PPE
      - arc flash hazard PPE
      - hard hats
      - safety glasses
      - safety footwear
      - gloves
      - hearing protection
      - respiratory protection
   ii) safety equipment
      - fall protection (fall arrest and fall restraint)
      - confined space equipment
      - lock-out and tag-out
      - fire extinguishers
      - first aid equipment
      - eye wash stations
      - signage
      - fume and toxic gas detectors

5. Describe the procedures used to maintain and store PPE and safety equipment.

6. Describe containment methods for designated substances.
   i) asbestos
   ii) lead
   iii) mercury
   iv) silica

7. Describe lock-out and tag-out procedures and legislation governing minimum standards.

8. Describe safety checks to be performed to ensure zero energy state.

9. Describe the procedures for voltage testing.

10. Describe the procedures used to determine if testing equipment is matched to voltage and energy rating.

Practical Objectives:

N/A

ELE-105 Tools and Equipment

Learning Outcomes:

- Demonstrate knowledge of tools and equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of limitations and ratings of electrical measuring equipment.
- Demonstrate knowledge of certification requirements to operate powder-actuated tools.

IEL 2021 Red Seal Occupational Standard Reference:

2.01 Uses common and specialty tools and equipment.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with tools and equipment.

2. Identify hazards and describe safe work practices pertaining to the use of tools and equipment.

3. Identify types of tools and equipment and describe their applications and procedures for use.
   i) standard tools
   ii) power tools and equipment
   iii) specialty tools and equipment
   iv) measuring equipment

4. Identify electrical measuring equipment for various ratings and describe their limitations.

5. Identify categories of electrical measuring equipment.

6. Describe certification requirements to operate powder-actuated tools.

7. Describe the procedures used to inspect, maintain and store tools and equipment.

Practical Objectives:
N/A

ELE-110 Access Equipment

Learning Outcomes:

- Demonstrate knowledge of access equipment, its applications, maintenance and procedures for use.
- Demonstrate knowledge of regulatory requirements pertaining to access equipment.

IEL 2021 Red Seal Occupational Standard Reference:

2.02 Uses access equipment.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with access equipment.

2. Identify hazards and describe safe work practices pertaining to access equipment.

3. Interpret codes, regulations and standards pertaining to access equipment.
   i) inspection documentation
   ii) training and certification

4. Identify types of access equipment and describe their characteristics, applications and limitations.
   i) ladders
   ii) scissor-lifts
   iii) scaffolding
   iv) articulating booms

5. Describe the procedures used to inspect, maintain and store access equipment.

Practical Objectives:

N/A

ELE-115 Hoisting, Lifting and Rigging

Learning Outcomes:

- Demonstrate knowledge of hoisting, lifting and rigging equipment, their applications, limitations and procedures for use.
- Demonstrate knowledge of regulatory requirements pertaining to hoisting, lifting and rigging equipment.
- Demonstrate knowledge of basic hoisting and lifting operations.

IEL 2021 Red Seal Occupational Standard Reference:

2.03 Uses rigging, hoisting and lifting equipment.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with hoisting, lifting and rigging equipment.

2. Identify hazards and describe safe work practices pertaining to hoisting, lifting and rigging.
   - i) overhead hazards
   - ii) dropped loads
   - iii) damaged rigging hardware
   - iv) congested worksites
   - v) confined spaces
   - vi) open trenches

3. Interpret codes, regulations and standards pertaining to hoisting, lifting and rigging.
   - i) inspection documentation
   - ii) training and certification

4. Identify types of rigging equipment and accessories and describe their applications and procedures for use.

5. Identify types of hoisting and lifting equipment and accessories and describe their applications and procedures for use.
6. Describe the procedures used to inspect, maintain and store hoisting, lifting and rigging equipment.

7. Identify types of knots, hitches, splices and bends and describe their applications and procedures to tie them.

8. Describe considerations when rigging material or equipment for lifting.
   i) load characteristics
   ii) working load limit (WLL)
   iii) equipment and accessories
   iv) environmental factors
   v) anchor points
   vi) sling angles

9. Describe methods to communicate during hoisting, lifting and rigging operations.
   i) hand signals
   ii) electronic communications
   iii) audible/visual

Practical Objectives:

1. Tie common knots.

ELE-120 Support Components

Learning Outcomes:

- Demonstrate knowledge of procedures to fabricate support structures.
- Demonstrate knowledge of brackets, hangers and fasteners, their characteristics and applications.
- Demonstrate knowledge of procedures to install brackets, hangers and fasteners.
- Demonstrate knowledge of measurement and layout techniques.
- Demonstrate knowledge of seismic restraint systems, their characteristics and applications.
- Demonstrate knowledge of procedures to install seismic restraint systems.

IEL 2021 Red Seal Occupational Standard Reference:

4.01 Fabricates support structures.
4.02 Installs brackets, hangers and fasteners.
4.03 Installs seismic restraint systems.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with support components.

2. Identify hazards and describe safe work practices pertaining to support structures.

3. Create, interpret and extract information pertaining to support structures from sketches, drawings and specifications.

4. Identify support materials, their characteristics and applications.
   i) wood
   ii) steel
   iii) aluminum

5. Identify tools and equipment used to fabricate and install support components and describe their applications and procedures for use.

6. Describe the procedures used to fabricate support structures.

7. Identify types of brackets, hangers and fasteners and describe their characteristics and applications.
    i) brackets
        - channel
        - angle
        - T
        - L
        - floor
        - ceiling
    ii) hangers
        - trapezes
        - pipe clamps
        - beam clamps
    iii) fasteners
        - spring nuts
        - bolts
        - screws
        - concrete anchors

8. Describe the procedures used to secure brackets, hangers and fasteners to structure.

9. Identify building materials and describe their characteristics and applications.
    i) steel
    ii) concrete
    iii) brick
    iv) block
    v) wood

10. Identify measurement and layout techniques used to ensure brackets, hangers and fasteners are positioned and mounted.

11. Identify types of seismic restraint systems and describe their characteristics and applications.
    i) chains
    ii) cables
    iii) rods
    iv) galvanized cable
    v) stainless steel cable
    vi) thimbles and clamps
12. Describe the procedures used to mount and secure seismic restraint systems to structures.

Practical Objectives:
N/A

ELE-125 Trade Documentation

Learning Outcomes:

- Demonstrate knowledge of trade documentation, its purpose and use.
- Demonstrate knowledge of procedures to complete and interpret documentation.

IEL 2021 Red Seal Occupational Standard Reference:

3.06 Finalizes required documentation.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Identify types of trade documentation and describe their applications.
   - i) work orders
   - ii) invoices
   - iii) reports
   - iv) logs
   - v) labels
   - vi) maintenance sheets

2. Describe the purpose of starting up, shutting down, commissioning and decommissioning and the types of systems and equipment requiring it.

3. Identify types of reference materials and sources of information and describe their applications.
   - i) technical manuals
   - ii) manufacturers' specifications
   - iii) equipment parameters
   - iv) drawings and schematics
   - v) regulations and standards
   - vi) permits
   - vii) material take-off lists

4. Describe the procedures used to finalize documentation.

Practical Objectives:
N/A

MENT-700 Mentoring I

Learning Outcomes:

- Demonstrate knowledge of effective communication practices as a learner.
- Demonstrate knowledge of strategies for learning skills in the workplace.

IEL 2021 Red Seal Occupational Standard Reference:

6.01 Uses communication techniques.
6.02 Uses mentoring techniques.

Suggested Hours:

6 hours

Theoretical Objectives:

1. Describe the importance of one's own individual experiences.

2. Identify behaviours that demonstrate positive learning experiences.

3. Identify the benefits of workplace mentoring for the apprentice, mentor and employer.

4. Identify the partners involved in apprenticeship training.

5. Describe the shared responsibilities for workplace learning in apprenticeship.

6. Identify different learning needs and strategies to address challenges or barriers in the workplace.
   i) learning disabilities
   ii) language
   iii) underrepresentation

7. Identify the components that create a positive and inclusive workplace culture.
   i) workplace characteristics
   ii) individual behaviours

8. Identify various learning styles and determine one’s own learning preferences.

9. Explain how learning preferences impact learning new skills.

10. Identify different learning strategies to meet individual learning needs.

11. Describe the importance of adapting to a variety of teaching and learning methods in the workplace.

12. Identify techniques for effective communication as a learner.
    i) verbal and non-verbal
    ii) active listening

13. Identify and describe personal responsibilities and attitudes that contribute to on-the-job success.
    i) self advocating
    ii) asking questions
    iii) accepting constructive feedback
    iv) working safely
    v) employing time management techniques and being punctual

Practical Objectives:

N/A

ELE-135 Drawings, Schematics and Specifications I

Learning Outcomes:

- Demonstrate knowledge of drawings, schematics and specifications and their applications.
- Demonstrate knowledge of imperial and metric units in trade documentation.
- Demonstrate knowledge of interpreting and extracting information from basic drawings, schematics and specifications.

IEL 2021 Red Seal Occupational Standard Reference:

3.01 Interprets plans, drawings and specifications.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with drawings, schematics and specifications.

2. Identify types of drawings, schematics and specifications and describe their applications.
   - i) civil/site
   - ii) architectural
   - iii) mechanical
   - iv) structural
   - v) electrical
   - vi) shop
   - vii) sketches
   - viii) as-builts

3. Interpret imperial and metric units of measure used in trade documentation.

4. Interpret and extract information from basic drawings, schematics and specifications.
   - i) elevations
   - ii) scales
   - iii) legends
   - iv) symbols and abbreviations
   - v) notes and specifications
   - vi) addendums
   - vii) Construction Specifications Canada (CSC)
     - specification divisions 25, 26, 27 and 28

5. Explain how scaling is performed to position devices.
   i) metric
   ii) imperial

6. Explain how three-dimensional (3D) modelling and building information modelling (BIM) digital blueprints can facilitate construction methods such as interpreting and updating drawings.

7. Describe how mobile devices can receive specifications and other relevant information to assist in diagnostic procedures.

Practical Objectives:

N/A

ELE-140 Worksite Preparation and Organization

Learning Outcomes:

- Demonstrate knowledge of procedures to plan and organize materials and supplies.
- Demonstrate knowledge of procedures to prepare worksite.
- Demonstrate knowledge of procedures to locate elements encased in concrete and soil.

IEL 2021 Red Seal Occupational Standard Reference:

3.03 Organizes materials and supplies.
3.04 Plans project tasks and procedures.
3.05 Prepares specific location in facility.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Identify sources of information relevant to organize materials and supplies.
   i) drawings
   ii) specifications
   iii) client requirements

2. Describe considerations to organize materials and supplies.
   i) available space
   ii) schedule
   iii) storage location

3. Identify sources of information relevant to prepare the worksite.
   i) drawings
   ii) specifications
   iii) authority having jurisdiction (AHJ)
   iv) client requirements

4. Identify hazards and describe safe work practices when preparing the worksite.
   i) confined spaces
   ii) open trenches
   iii) overhead hazards
   iv) uneven ground
   v) high traffic area
   vi) elevated work areas
   vii) underground hazards

viii) leading edges

5. Describe considerations to prepare the worksite.
   i) available space
   ii) schedule/sequence
   iii) permits
   iv) hazards assessment
   v) personnel
   vi) tools and equipment
   vii) materials and supplies
   viii) storage location

6. Identify elements in concrete walls and floors, slab on grade and in soil and the types of surveying equipment used to locate them.
   i) conduits
   ii) heating cables
   iii) pipes
   iv) reinforcement bar
   v) post-tensioned cables

7. Describe safety requirements when using x-ray surveying equipment in occupied buildings.

Practical Objectives:

N/A

ELE-145 DC Theory

Learning Outcomes:

- Demonstrate knowledge of direct current (DC) electricity and associated principles.
- Demonstrate knowledge of basic electric circuits and components.
- Demonstrate knowledge of ohm's law.
- Demonstrate knowledge of units of measure and symbols relating to DC electricity.
- Demonstrate knowledge of the instruments and procedures used to measure electricity.
- Demonstrate knowledge of calculating values of voltage, current, resistance and power in electric circuits.

IEL 2021 Red Seal Occupational Standard Reference:

N/A

Suggested Hours:

30 Hours

Theoretical Objectives:

1. Define terminology associated with DC electricity.

2. Identify hazards and describe safe work practices pertaining to DC electricity.

3. Explain atomic structure of matter and electron theory.
   i) conductors
   ii) semi-conductors
   iii) insulators

4. Identify the forms of energy that produce electricity and describe their associated principles.
   i) chemical action
   ii) piezoelectric effect
   iii) mechanical/magnetism
   iv) heat
   v) light and solar
   vi) friction

5. Describe basic electric circuits.
   i) electron path (conductors)
   ii) load
   iii) source

iv) control

6. Identify basic components found in DC electric circuits and describe their purpose and operation.

7. Identify units of measure and symbols pertaining to DC electricity.

8. Explain Ohm's Law.

9. Identify basic electrical properties and describe their relationship.
   i) voltage
   ii) current
   iii) resistance
   iv) power

10. Identify instruments used for measuring electricity and describe their applications and procedures for use.

11. Perform calculations to determine the values of voltage, current, resistance and power in simple electric circuits.

Practical Objectives:

1. Use instruments to troubleshoot DC components.
   i) closed circuit
   ii) open circuit

ELE-150 DC Circuits

Learning Outcomes:

- Demonstrate knowledge of series, parallel and complex DC circuits, their characteristics and operation.
- Demonstrate knowledge of Kirchhoff's law.
- Demonstrate knowledge of calculations for DC circuit values.
- Demonstrate knowledge of procedures to troubleshoot DC circuits.

IEL 2021 Red Seal Occupational Standard Reference:

N/A

Suggested Hours:

30 Hours

Theoretical Objectives:

1. Define terminology associated with DC circuits.

2. Explain the characteristics and operation of series DC circuits.

3. Explain the characteristics and operation of parallel DC circuits.

4. Identify types of complex DC circuits and describe their characteristics and operation.
   i) series-parallel
   ii) parallel-series

5. Explain Kirchoff's Laws.
   i) current
   ii) voltage

6. Perform calculations to determine series, parallel and complex DC circuit related values.

7. Describe the procedures used to troubleshoot series, parallel and complex DC circuits.

Practical Objectives:

1. Use instruments to troubleshoot series, parallel and complex DC circuits.

ELE-155 Single-Phase AC Theory

Learning Outcomes:

- Demonstrate knowledge of single-phase electricity, its characteristics, and associated principles.
- Demonstrate knowledge of AC components and their characteristics.
- Demonstrate knowledge of calculations for single-phase circuit values.

IEL 2021 Red Seal Occupational Standard Reference:

N/A

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with single-phase electricity.

2. Identify hazards and describe safe work practices pertaining to single-phase electricity.

3. Identify units of measure and symbols pertaining to single-phase electricity.

4. Explain the principles of magnetism.

5. Explain the principles of electromagnetism.

6. Explain the principles of electromagnetic induction.

7. Identify types of electromagnetic induction and describe their characteristics and applications.
   i) self-induction
   ii) mutual induction

8. Explain alternating current (AC).
   i) sine wave values and characteristics
      - instantaneous
      - peak
      - peak to peak
      - RMS
      - average (DC level)

9. Identify types of components found in AC circuits and describe their purpose and operation.
    i) resistors
    ii) inductors
    iii) capacitors

10. Perform calculations pertaining to single-phase theory.

Practical Objectives:

N/A

ELE-160 Single-Phase AC Circuits I

Learning Outcomes:

- Demonstrate knowledge of series and parallel AC circuits and components, their characteristics and operation.
- Demonstrate knowledge of AC circuit calculations for series, parallel and three-wire configurations.
- Demonstrate knowledge of procedures to troubleshoot AC circuits.

IEL 2021 Red Seal Occupational Standard Reference:

N/A

Suggested Hours:

30 Hours

Theoretical Objectives:

1. Define terminology associated with series and parallel AC circuits.

2. Explain the characteristics and operation of series AC circuits.

3. Explain the characteristics and operation of parallel AC circuits.

4. Explain Kirchoff's Laws.
   i) current
   ii) voltage

5. Identify types of components found in AC circuits and describe their purpose and operation.
   i) resistors
   ii) inductors
   iii) capacitors

6. Perform calculations to determine series and parallel AC circuit related values.
   i) resistance in series/parallel
   ii) inductance in series/parallel
   iii) capacitance in series/parallel

7. Explain single-phase three-wire systems and describe their characteristics, purpose, and operation.

8. Perform single-phase three-wire system calculations.
    i) Edison three-wire
    ii) open neutral circuit values

9. Describe the procedures used to troubleshoot series and parallel AC circuits.

Practical Objectives:

1. Use electrical instruments to troubleshoot series and parallel AC circuits.

ELE-165 Introduction to the Canadian Electrical Code

Learning Outcomes:

- Demonstrate knowledge of the layout of the Canadian Electrical Code (CEC).
- Demonstrate knowledge of procedures to locate and interpret information in the Canadian Electrical Code (CEC).

IEL 2021 Red Seal Occupational Standard Reference:

N/A

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with the CEC.

2. Explain the layout of the CEC.
   i) sections
   ii) appendices
   iii) tables
   iv) indexes

3. Identify methods to locate information in the CEC and describe their associated procedures.
   i) by keyword in index
   ii) by subject area

Practical Objectives:

1. Locate and interpret information in the CEC.

ELE-170 Grounding and Bonding Systems I

Learning Outcomes:

- Demonstrate knowledge of grounding and bonding methods and equipment.
- Demonstrate knowledge of procedures to install grounding systems.
- Demonstrate knowledge of procedures to install bonding systems.

IEL 2021 Red Seal Occupational Standard Reference:

11.01 Installs grounding systems.
11.03 Installs bonding systems.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with grounding and bonding.

2. Identify hazards and describe safe work practices pertaining to grounding and bonding.

3. Interpret codes, regulations and standards pertaining to grounding and bonding.

4. Interpret information pertaining to grounding and bonding found on drawings and specifications.

5. Identify tools and equipment used to install grounding and bonding systems and describe their applications and procedures for use.

6. Identify grounding methods.

7. Identify bonding methods.

8. Identify grounding conductors, equipment and components and describe their characteristics and applications.

9. Identify bonding conductors, equipment and components and describe their characteristics and applications.
10. Identify considerations and requirements for selecting grounding conductors, methods, equipment and components.

11. Identify considerations and requirements for selecting bonding conductors, methods, equipment and components.

12. Explain purpose and differences between grounding and bonding and identify situations where interconnection of bonding is required.

13. Describe the procedures used to install grounding systems.

14. Describe the procedures used to calculate grounding conductor size.

15. Describe the procedures used to install bonding systems.

16. Describe the procedures used to calculate bonding conductor size.

Practical Objectives:

N/A

ELE-175 Single-Phase Services

Learning Outcomes:

- Demonstrate knowledge of single-phase services and applications.
- Demonstrate knowledge of procedures to install single-phase services.
- Demonstrate knowledge of load calculations for single-phase service.
- Demonstrate knowledge of procedures to service and maintain single-phase services.
- Demonstrate knowledge of procedures to commission, start up, shut down and decommission single-phase services.

IEL 2021 Red Seal Occupational Standard Reference:

5.01 Commissions systems.
5.02 Performs shutdown and startup procedures.
5.03 Decommissions systems.
7.01 Installs single-phase utility and non-utility supply services and metering equipment
7.02 Maintains single-phase utility and non-utility supply services and metering equipment.
8.01 Installs overcurrent protection devices.
8.02 Maintains overcurrent protection devices.
8.03 Installs ground fault, arc fault and surge protection devices.
8.04 Maintains ground fault, arc fault and surge protection devices.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with single-phase services.

2. Identify hazards and describe safe work practices pertaining to single-phase services.
3. Interpret codes, regulations and standards pertaining to single-phase services.

4. Interpret information pertaining to single-phase services found on drawings and specifications.

5. Identify types of single-phase services and describe their characteristics and applications.
   i) temporary service
   ii) overhead
   iii) underground
   iv) single metering

v) multiple metering

6. Identify service components, service conductors and fasteners and describe their purpose and applications.

7. Identify considerations and requirements for selecting the type of single-phase services, service components and service conductors.

8. Identify sources of information and documentation required for the installation of single-phase services.
   i) drawings
   ii) disposal documents
   iii) work orders
   iv) permits
   v) supply authority documentation
   vi) terminal identification

9. Identify types of tools and equipment used to install and maintain single-phase services and describe their applications and procedures for use.

10. Describe the procedures used to install single-phase services, service components and service conductors.

11. Describe the procedures used to connect service conductors.

12. Describe the procedures used to ground and bond single-phase services.

13. Describe the procedures used to calculate load for single-phase services.

14. Describe the procedures used to service single-phase services and their components.

15. Describe the procedures used to maintain single-phase services and their components.

16. Describe the procedures used to commission, start up, shut down and decommission single-phase services.

17. Identify types of protection devices used with single-phase services and describe their applications.

Practical Objectives:

1. Install a single-phase service.

ELE-180 Single-Phase Power Distribution Equipment

Learning Outcomes:

- Demonstrate knowledge of single-phase/low-voltage power distribution equipment, their applications and operation.
- Demonstrate knowledge of procedures to install single-phase/low-voltage power distribution equipment.
- Demonstrate knowledge of calculations for single-phase power distribution equipment ratings.
- Demonstrate knowledge of procedures to service and maintain single-phase/low-voltage power distribution equipment.
- Demonstrate knowledge of procedures to commission, start up, shut down and decommission single-phase/low-voltage power distribution equipment.

IEL 2021 Red Seal Occupational Standard Reference:

5.01 Commissions systems.
5.02 Performs shutdown and startup procedures.
5.03 Decommissions systems.
8.05 Installs under- and over-voltage protection devices.
8.06 Maintains under- and over-voltage protection devices.
9.01 Installs low-voltage distribution equipment.
9.02 Maintains low-voltage distribution equipment.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with single-phase power distribution equipment.

2. Identify hazards and describe work practices pertaining to single-phase power distribution equipment.

3. Interpret codes, regulations and standards pertaining to single-phase power distribution equipment.

4. Interpret information pertaining to single-phase power distribution equipment found on drawings and specifications.

5. Identify types of single-phase power distribution equipment and describe their characteristics, applications and operation.

6. Identify tools and equipment used to install, service and maintain single-phase power distribution equipment and describe their applications and procedures for use.

7. Identify considerations and requirements for selecting single-phase power distribution equipment and enclosures.
   i) load
   ii) voltage ratings
   iii) required circuit capacity/amperage ratings

8. Describe the procedures used to install single-phase power distribution equipment.

9. Describe the procedures used to connect single-phase power distribution equipment.

10. Describe the procedures for transporting and moving single-phase electrical equipment.

11. Perform calculations to determine single-phase distribution equipment ratings.
   i) panels/sub-panels
   ii) disconnects
   iii) overcurrent devices

12. Describe the procedures used to service single-phase power distribution equipment and their components.

13. Describe the procedures used to maintain single-phase power distribution equipment and their components.

14. Describe the procedures to commission, start up, shut down, and decommission single-phase power distribution equipment.

15. Identify types of protection devices used with single-phase power distribution equipment and describe their applications.

Practical Objectives:

N/A

ELE-185 Conductors and Cables

Learning Outcomes:

- Demonstrate knowledge of conductors and cables, their components, applications and operations.
- Demonstrate knowledge of procedures to install conductors and cables.
- Demonstrate knowledge of the procedures to service and maintain cables.

IEL 2021 Red Seal Occupational Standard Reference:

16.01 Installs conductors and cables.
16.02 Maintains conductors and cables.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with conductors and cables.

2. Identify hazards and describe safe work practices pertaining to conductors and cables.

3. Interpret codes, regulations and standards pertaining to conductors and cables.

4. Interpret information pertaining to conductors and cables found on drawings and specifications.

5. Identify types of conductors and cables and describe their characteristics and applications.

6. Identify conductor and cable components and describe their characteristics and applications.
   i) mechanical fittings
   ii) compression fittings
   iii) straps
   iv) connectors
   v) hangers
   vi) heat shrink
   vii) anti-oxidant compound

7. Identify tools and equipment used to install, service and maintain conductors and cables and describe their applications and procedures for use.

8. Identify considerations and requirements for removal of conductors, cables, and their components.

9. Identify considerations and requirements for selecting conductors, cables, and their components.

10. Identify considerations and requirements for installing conductors, cables, and their components and accessories.
    i) conduit fill
    ii) methods of pulling conductors/cables
    iii) de-rating factors
    iv) routing
    v) location

11. Describe the procedures used to remove conductors, cables, and their components.

12. Describe the procedures used to prepare and install conductors, cables, and their components.

13. Describe the procedures used to splice conductors and cables.

14. Describe the procedures used to terminate conductors and cables.

15. Describe the procedures used to service cables.

16. Identify considerations when maintaining cables.
    i) changes from original installation
    ii) heat points
    iii) physical damage
    iv) information from end user

17. Describe the procedures used to maintain cables.

Practical Objectives:

1. Install, splice and terminate conductors and cables.

ELE-190 Conduit, Tubing and Fittings

Learning Outcomes:

- Demonstrate knowledge of conduit, tubing and fittings, their components and applications.
- Demonstrate knowledge of procedures to install conduit, tubing and fittings.
- Demonstrate knowledge of procedures to maintain conduit, tubing and fittings.

IEL 2021 Red Seal Occupational Standard Reference:

16.03 Installs conduit, tubing and fittings.
16.06 Maintains conduit, tubing, fittings, raceways, boxes and enclosures.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with conduit, tubing and fittings.

2. Identify hazards and describe safe work practices pertaining to conduit, tubing and fittings.
   i) environmental conditions
   ii) situations and inside/outside conditions that can cause damage on specific types of conduit, tubing and fittings

3. Interpret codes, regulations and standards pertaining to conduit, tubing and fittings.

4. Interpret information pertaining to conduit, tubing and fittings found on drawings and specifications.

5. Identify types of conduit, tubing and fittings and describe their characteristics, applications and limitations.
   i) electrical metallic tubing (EMT)
   ii) rigid PVC
   iii) flexible conduit
   iv) rigid metal
   v) electrical non-metallic tubing (ENT)
   vi) direct burial 2 (DB2)

6. Perform calculations to determine conduit size.

7. Identify conduit, tubing and fitting components and describe their characteristics and applications.

8. Identify considerations and requirements for selecting conduit, tubing and fittings, and their components.
   i) calculate conduit expansion

9. Identify tools and equipment used to install and maintain conductors and cables and describe their applications and procedures for use.

10. Describe the procedures used to remove conduit and tubing.

11. Describe the procedures used to cut, thread (if applicable) and bend conduit and tubing.

12. Describe the procedures used to install and support conduit and tubing systems and components.

13. Identify considerations when maintaining conduit, tubing and fittings.
   i) corrosion
   ii) condition of supports
   iii) tightness and presence of mounting screws
   iv) tightness of locknuts
   v) physical damage
   vi) cleanliness

14. Describe the procedures to repair or replace conduit, tubing and fittings.

15. Describe the procedures used to tighten or adjust conduit, tubing and fittings.

16. Describe the procedures used to clean conduit, tubing and fittings.

Practical Objectives:

1. Cut and bend conduit and tubing.

ELE-195 Raceways

Learning Outcomes:

- Demonstrate knowledge of raceways, their components and applications.
- Demonstrate knowledge of procedures to install raceways.
- Demonstrate knowledge of procedures to service and maintain raceways.

IEL 2021 Red Seal Occupational Standard Reference:

16.04 Installs raceways.
16.06 Maintains conduit, tubing, fittings, raceways, boxes and enclosures.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with raceways.

2. Identify hazards and describe safe work practices pertaining to raceways.

3. Interpret codes, regulations and standards pertaining to raceways.

4. Interpret information pertaining to raceways found on drawings and specifications.

5. Identify types of raceways and describe their characteristics and applications.
   i) cable tray
   ii) underfloor raceways
   iii) busways
   iv) cellular raceways
   v) surface raceways
   vi) wire trays/wireways
   vii) bus ducts
   viii) cable bus

6. Identify raceway components and describe their characteristics and applications.
   i) fittings (couplings and connectors)
   ii) supports
   iii) expansion joints
   iv) floor boxes
   v) junction boxes

7. Identify tools and equipment used to install and maintain raceways and describe their applications and procedures for use.

8. Identify considerations and requirements for removal of raceways and their components.

9. Identify considerations and requirements for selecting raceways and their components.

10. Describe the procedures used to remove raceways and their components.

11. Describe the procedures used to install and support raceways and their components.

12. Identify considerations when servicing and maintaining raceways.
    i) changes from original installation
    ii) heat points
    iii) physical damage
    iv) information from end user

13. Describe the procedures used to service and maintain raceways.

Practical Objectives:

N/A

ELE-196 Boxes and Enclosures

Learning Outcomes:

- Demonstrate knowledge of boxes and enclosures and their applications.
- Demonstrate knowledge of procedures install boxes and enclosures.
- Demonstrate knowledge procedures to service and maintain boxes and enclosures.

IEL 2021 Red Seal Occupational Standard Reference:

16.05 Installs boxes and enclosures.
16.06 Maintains conduit, tubing, fittings, raceways, boxes and enclosures.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with boxes and enclosures.

2. Identify hazards and describe safe work practices pertaining to boxes and enclosures.

3. Interpret codes, regulations and standards pertaining to boxes and enclosures.

4. Interpret information pertaining to boxes and enclosures found on drawings and specifications.

5. Identify types of boxes and enclosures and describe their characteristics and applications.
   - i) device
   - ii) utility
   - iii) FS/FD
   - iv) masonry
   - v) square
   - vi) octagon
   - vii) pancake
   - viii) power and communication
   - ix) 347 V
   - x) pull
   - xi) splitter

6. Identify tools and equipment used to install, service and maintain support boxes and enclosures and describe their applications and procedures for use.

7. Identify considerations and requirements for removal of boxes and enclosures.

8. Identify considerations and requirements for selecting boxes and enclosures.
   i) volume
   ii) environment
   iii) accessibility
   iv) size of raceway or cable entering the box or enclosure
   v) CSA/NEMA classification

9. Describe the procedures used to remove boxes and enclosures.

10. Describe the procedures used to install and support boxes and enclosures.

11. Identify considerations when servicing and maintaining boxes and enclosures.

12. Describe the procedures used to service and maintain boxes and enclosures.

Practical Objectives:

N/A

ELE-197 Wiring Devices

Learning Outcomes:

- Demonstrate knowledge of wiring devices, their applications and operation.
- Demonstrate knowledge of procedures to install wiring devices.
- Demonstrate knowledge of procedures to service and maintain wiring device components.

IEL 2021 Red Seal Occupational Standard Reference:

17.03 Installs wiring devices.
17.04 Maintains wiring devices.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with wiring devices.

2. Identify hazards and describe safe work practices pertaining to wiring devices.

3. Interpret codes, regulations and standards pertaining to wiring devices.

4. Interpret information pertaining to wiring devices found on drawings and specifications.

5. Identify types of wiring devices and describe their applications and operation.
   i) lampholders
   ii) indicator lamps
   iii) switches
   iv) sensors
   v) safety switches
   vi) power outlets
   vii) receptacles

6. Identify tools and equipment used to install, service and maintain wiring devices and components and describe their applications and procedures for use.
7. Identify considerations and requirements for removal of wiring devices.

8. Identify considerations and requirements for selection of wiring devices.

9. Describe the procedures used to remove wiring devices.

10. Describe the procedures used to install wiring devices.

11. Describe the procedures used to service and maintain wiring device components.

Practical Objectives:

N/A

ELE-198 Luminaires and Lighting Controls

Learning Outcomes:

- Demonstrate knowledge of luminaires and lamps, their applications and operation.
- Demonstrate knowledge of procedures used to install luminaires and lamps.
- Demonstrate knowledge of lighting control components, their applications and operation.
- Demonstrate knowledge of procedures to install lighting control components.
- Demonstrate knowledge of procedures to service and maintain luminaires, lamps and lighting control components.

IEL 2021 Red Seal Occupational Standard Reference:

17.01 Installs luminaires.
17.02 Maintains luminaires.

Suggested Hours :

24 Hours

Theoretical Objectives:

1. Define terminology associated with luminaires and lighting controls.

2. Identify hazards and describe safe work practices pertaining to luminaires and lighting controls.

3. Interpret codes, regulations and standards pertaining to lighting systems.
   i) luminaires and lamps
   ii) lighting controls

4. Interpret information pertaining to lighting systems found on drawings and specifications.
   i) luminaires and lamps
   ii) lighting controls

5. Identify types of luminaires and lamps and describe their applications and operations.
   i) luminaires
      - pole mounted
      - wall mounted
      - ceiling mounted
      - pendant
      - surface

- recessed

ii) lamps
- high intensity discharge (HID)
- light emitting diode (LED)
- incandescent
- fluorescent
- ultraviolet
- infrared
- low pressure sodium
- quartz
- induction

6. Identify luminaire and lamp components and describe their characteristics and applications.

7. Identify considerations and requirements for removal of luminaires, lamps and their components.

8. Identify considerations and requirements for selecting luminaires, lamps and their components.

9. Describe the procedures used to remove luminaires, lamps and their components.

10. Describe the procedures used to install and support luminaires, lamps and their components.

11. Describe the procedures used to perform tests related to luminaires and lamps.

12. Identify types of lighting control components and describe their characteristics and applications.
    i) extra low-voltage switching
    ii) line voltage switching
    iii) time clocks
    iv) ambient light sensor
    v) programmable lighting controller
    vi) photo cells and motion sensors
    vii) relays
    viii) occupancy sensors

13. Identify tools and equipment used to install, service and maintain luminaires and lamps and describe their applications and procedures for use.

14. Identify considerations and requirements for removal and disposal of lighting control components.

15. Identify considerations and requirements for selecting lighting control components.

16. Describe the procedures used to remove lighting control components.

17. Describe the procedures used to install lighting control components.

18. Describe the procedures used to connect lighting control components.

19. Describe the procedures used to test lighting control components.

20. Describe the procedures used to troubleshoot luminaires, lamps and lighting control components.

21. Describe the procedures used to repair/replace luminaires, lamps and lighting control components.

22. Describe the procedures used to install modular wiring systems in luminaires, lamps and lighting controls.
    i) quick connect/disconnect
    ii) smart lighting systems

23. Identify electronic components and describe their application as it pertains to luminaires and lightning controls.

Practical Objectives:

1. Install a luminaire and lighting controls with operation from multiple locations.

ELE-199 Introduction to Communication Systems

Learning Outcomes:

- Demonstrate knowledge of communication systems and cabling

IEL 2021 Red Seal Occupational Standard Reference:

27.01 Installs communication systems.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with communication systems.

2. Interpret codes, regulations and standards pertaining to communication systems.
   i) minimum distances and separation requirements

3. Interpret information pertaining to communication systems found on drawings and specifications.

4. Identify types of communication systems and describe their basic characteristics, applications, and operation.
   i) voice/data/video (VDV)
   ii) closed-circuit television (CCTV)
   iii) public address
   iv) intercom
   v) nurse call

5. Identify basic communication system components and describe their characteristics and applications.
   i) cabling
   ii) termination levels
   iii) outlet jacks
   iv) face plates
   v) cable supports
   vi) connectors
   vii) splitters
   viii) terminators

6. Identify considerations and requirements for selecting basic communication systems and their components.

7. Describe the procedures used to install communication cabling.

8. Explain the purpose and benefits of shielded communication cable.

Practical Objectives:

N/A

Level 2

ELE-220 Job Planning

Learning Outcomes:

- Demonstrate knowledge of procedures to plan and organize job tasks.

IEL 2021 Red Seal Occupational Standard Reference:

3.04 Plans project tasks and procedures.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Identify sources of information relevant to planning job tasks and procedures.
   - i) drawings
   - ii) specifications
   - iii) client requirements

2. Describe considerations to plan and organize job tasks and procedures.
   - i) available space
   - ii) schedule/sequence
   - iii) permits
   - iv) hazard assessment
     - assessment form sample
   - v) personnel
   - vi) tools and equipment
   - vii) materials and supplies
   - viii) storage location/laydown area
   - ix) accessible installation awareness
   - x) sustainability and environmentally friendly techniques

3. Describe the function of project schedule charts.

Practical Objectives:

N/A

ELE-225 Voltage Drop and Power Loss

Learning Outcomes:

- Demonstrate knowledge of conductor materials and characteristics.
- Demonstrate knowledge of voltage drop and power loss and its impact on a circuit.
- Demonstrate knowledge of calculations for voltage drop and power loss values.

IEL 2021 Red Seal Occupational Standard Reference:

N/A

Suggested Hours:

30 Hours

Theoretical Objectives:

1. Define terminology associated with voltage drop and power loss.
2. Interpret codes, regulations and standards pertaining to voltage drop and power loss.
3. Identify types of conductor materials and describe their characteristics and applications.
4. Identify the units of measure used to describe conductor size.
5. Explain conductor resistance and its effect on a circuit.
6. Describe the procedures used to determine conductor resistance.
7. Explain line voltage drop and its effect on a circuit.
8. Perform calculations to determine line voltage drop.
9. Explain power loss and its effect on a circuit.
10. Perform calculations to determine power loss.

Practical Objectives:

N/A

ELE-230 Environmental and Hazardous Installations

Learning Outcomes:

- Demonstrate knowledge of environmental conditions and installation procedures.
- Demonstrate knowledge of procedures to prepare worksite.
- Demonstrate knowledge of hazardous locations.
- Demonstrate knowledge of hazardous locations wiring methods.
- Demonstrate knowledge of procedures to service and maintain equipment and components in hazardous locations.

IEL 2021 Red Seal Occupational Standard Reference:

1.01 Maintains safe work environment.
1.04 Identifies environmental conditions.
3.02 Identifies hazardous installations.
3.05 Prepares specific location in facility.
16.01 Installs conductors and cables.
16.02 Maintains conductors and cables.
16.03 Installs conduit, tubing and fittings.
16.04 Installs raceways.
16.05 Installs boxes and enclosures.
16.06 Maintains conduit, tubing, fittings, raceways, boxes and enclosures.

Suggested Hours:

24 Hours

Theoretical Objectives:

1. Identify types of hazardous locations and describe safe work practices.
   i) explosive gas
   ii) explosive and combustible dust
   iii) combustible fibers and flyings
2. Interpret codes, regulations and standards pertaining to electrical installations in hazardous locations.

3. Interpret information pertaining to electrical installations in hazardous locations found on drawings and specifications.

4. Identify types of environmental conditions and describe safe work procedures.
   i) wet
   ii) dusty

iii) corrosive
iv) hot
v) cold

5. Identify equipment designed for installation and operation in areas according to environmental conditions.

6. Identify and describe wiring procedures and methods for areas according to environmental conditions.

7. Describe how hazardous locations are classified using the division system.

8. Identify types of potentially hazardous materials present and the procedures used to designate an area to be a hazardous location.

9. Identify equipment and fittings designed for installation and operation in hazardous locations.
   i) conductors and cables
   ii) conduit tubing and fittings
   iii) raceways
   iv) boxes and enclosures
   v) lighting equipment and controls
   vi) wiring devices

10. Identify and describe wiring methods for use in hazardous locations.

11. Describe the procedures used to install and connect electrical components, devices and equipment in hazardous locations.

12. Describe the procedures used to service electrical components, devices and equipment in hazardous locations.

13. Describe the procedures used to maintain electrical components, devices and equipment in hazardous locations.

Practical Objectives:

N/A

ELE-235 DC Generating and Conversion Systems

Learning Outcomes:

- Demonstrate knowledge of DC generating and conversion systems and components, their applications and operation.
- Demonstrate knowledge of procedures to install DC generating and conversion systems.
- Demonstrate knowledge of procedures to service and maintain DC generating and conversion systems.

IEL 2021 Red Seal Occupational Standard Reference:

11.01 Installs grounding systems.
11.03 Installs bonding systems.
12.03 Installs direct current (DC) generating and conversion systems.
12.04 Maintains DC generating and conversion systems.

Suggested Hours:

15 Hours

Theoretical Objectives:

1. Define terminology associated with DC generating and conversion systems.

2. Identify hazards and describe safe work practices pertaining to DC generating and conversion systems.

3. Interpret codes, regulations and standards pertaining to DC generating and conversion systems.

4. Interpret information pertaining to DC generating and conversion systems found on drawings and specifications.

5. Identify types of DC generating and conversion systems and explain their operating principles.
   i) portable
   ii) stationary
   iii) transfer methods (manual or automatic)

6. Identify types of DC generators and describe their characteristics and applications.
   i) series
   ii) shunt
   iii) compound

iv) portable
v) stationary

7. Identify DC generating and conversion system components and describe their characteristics and applications.
   i) transfer switch
   ii) prime mover
   iii) cables
   iv) conductors
   v) overcurrent devices
   vi) overload devices
   vii) fuel monitoring and storage
   viii) solid state rectifiers
   ix) transformers
   x) SCRs
   xi) IGBTs

8. Identify considerations and requirements for selecting DC generating and conversion systems and their components.

9. Identify tools and equipment used to install, service and maintain DC generating and conversion systems and describe their applications and procedures for use.

10. Describe the procedures used to install DC generating and conversion systems and their components.

11. Describe the procedures used to connect DC generating and conversion systems and their components.
   i) floating ground

12. Describe the procedures used to control the output voltage of DC generators.

13. Describe the procedures used to service DC generating and conversion systems and their components.

14. Describe the procedures used to maintain DC generating and conversion systems and their components.
15. Identify electronic components and describe their application as it pertains to DC generating systems.

16. Identify methods of grounding and bonding DC generating and conversion systems.

Practical Objectives:
N/A

ELE-240 Single-Phase AC Circuits II

Learning Outcomes:

- Demonstrate knowledge of series and parallel AC circuits and components, their characteristics and operation.
- Demonstrate knowledge of calculations for AC circuit-related values.

IEL 2021 Red Seal Occupational Standard Reference:

N/A

Suggested Hours:

27 Hours

Theoretical Objectives:

1. Define terminology associated with series and parallel AC circuits.

2. Explain the effects of electrical components found in series AC circuits.
   - i) resistance
   - ii) reactance
     - inductive
     - capacitive
   - iii) impedance

3. Explain the effects of electrical components found in parallel AC circuits.
   - i) resistance
   - ii) reactance
     - inductive
     - capacitive
   - iii) impedance

4. Perform calculations to determine series and parallel AC circuit-related values.
   - i) inductive reactance
   - ii) capacitive reactance
   - iii) RL
   - iv) RC
   - v) RLC
   - vi) phase angle
   - vii) true power, apparent power, reactive power
   - viii) power factor
   - ix) impedance

Practical Objectives:

N/A

ELE-245 Protection Devices

Learning Outcomes:

- Demonstrate knowledge of overcurrent protection devices, their applications and operation.
- Demonstrate knowledge of procedures to install overcurrent protection devices.
- Demonstrate knowledge of ground fault, arc fault and surge protection devices, their applications and operation.
- Demonstrate knowledge of procedures to install ground fault, arc fault and surge protection devices.
- Demonstrate knowledge of under and over-voltage protection devices, their applications and operation.
- Demonstrate knowledge of procedures to install under and over-voltage protection devices.
- Demonstrate knowledge of procedures to service and maintain protection devices.

IEL 2021 Red Seal Occupational Standard Reference:

8.01 Installs overcurrent protection devices.
8.02 Maintains overcurrent protection devices.
8.03 Installs ground fault, arc fault and surge protection devices.
8.04 Maintains ground fault, arc fault and surge protection devices.
8.05 Installs under- and over-voltage protection devices.
8.06 Maintains under- and over-voltage protection devices.
11.06 Maintains ground-fault protection and detection systems

Suggested Hours:

24 Hours

Theoretical Objectives:

1. Define terminology associated with protection devices.

2. Identify hazards and describe safe work practices pertaining to protection devices.

3. Interpret codes, regulations and standards pertaining to protection devices.
   i) overcurrent devices
   ii) ground fault devices
   iii) arc fault devices
   iv) surge protection devices
   v) under and over-voltage devices

4. Interpret information pertaining to protection devices found on drawings and specifications.
   i) overcurrent devices
   ii) ground fault devices
   iii) arc fault devices
   iv) surge protection devices
   v) under and over-voltage devices

5. Explain the purpose of updating required documentation.
   i) as-builts
   ii) schematics
   iii) panel schedules
   iv) log sheets
   v) drive drawings
   vi) shop drawings

6. Identify tools and equipment used to install, service and maintain protection devices and describe their applications and procedures for use.

7. Explain the purpose and operation of overcurrent protection devices.

8. Explain the effects of short-circuit current and describe the associated damage to the circuit.

9. Identify types of overcurrent protection devices and describe their characteristics and applications.
   i) fuses
   ii) breakers
   iii) relay protection

10. Identify considerations and requirements for selecting overcurrent protection devices.

11. Explain the purpose of coordination studies.

12. Describe the procedures used to install overcurrent protection devices.

13. Describe the procedures used to adjust trip settings.

14. Explain the purpose and operation of ground fault, arc fault and surge protection devices.

15. Identify types of ground fault, arc fault and surge protection devices.
   i) ground fault
      - GFCI receptacle

- breaker

ii) arc fault
- AFCI receptable
- breaker

iii) surge protection
- MOV
- zener diodes
- thyristors
- surge suppressors

16. Identify considerations and requirements for selecting ground fault, arc fault and surge protection devices.

17. Describe the procedures used to install ground fault, arc fault, and surge protection devices.

18. Explain the purpose and operation of under and over voltage protection devices.

19. Identify types of under and over-voltage protection devices.

20. Identify considerations and requirements for selecting under and over-voltage protection devices.

21. Describe the procedures used to install under and over-voltage protection devices.

22. Describe the procedures used to service protection devices.

23. Describe the procedures used to maintain protection devices.

24. Identify electronic components and describe their application as it pertains to protection devices.

Practical Objectives:

N/A

ELE-250 Extra-Low Voltage Transformers

Learning Outcomes:

- Demonstrate knowledge of extra-low voltage transformers and components, their applications and operation.
- Demonstrate knowledge of procedures to install extra-low voltage transformers.
- Demonstrate knowledge of procedures to service and maintain extra-low voltage transformers.

IEL 2021 Red Seal Occupational Standard Reference:

15.01 Installs extra-low voltage transformers.
15.02 Maintains extra-low voltage transformers.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with extra-low voltage transformers.

2. Identify hazards and describe safe work practices pertaining to extra-low voltage transformers.

3. Interpret information contained on extra-low voltage transformer nameplates.

4. Explain the operating principles of extra-low voltage transformers.

5. Identify types of extra-low voltage transformers and describe their characteristics and applications.
   i) Class 1 circuits (per CEC)
   ii) Class 2 circuits (per CEC)

6. Identify extra-low voltage transformer components and describe their characteristics and applications.
   i) casing
   ii) core
   iii) primary windings
   iv) secondary windings

7. Identify considerations and requirements for selecting extra-low voltage transformers.

8. Identify tools and equipment used to install, service and maintain extra-low voltage transformers and describe their applications and procedures for use.

9. Describe the procedures used to install extra-low voltage transformers and their components.

10. Describe the procedures used to service extra-low voltage transformers and their components.

11. Describe the procedures used to maintain extra-low voltage transformers and their components.

Practical Objectives:

N/A

ELE-255 Low-Voltage Single-Phase Transformers

Learning Outcomes:

- Demonstrate knowledge of low-voltage single-phase transformers and components, their applications and operation.
- Demonstrate knowledge of procedures to install low-voltage single-phase transformers.
- Demonstrate knowledge of procedures to service and maintain low-voltage single-phase transformers.

IEL 2021 Red Seal Occupational Standard Reference:

15.03 Installs low voltage single-phase transformers.
15.04 Maintains low voltage single-phase transformers.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with low-voltage single-phase transforms.

2. Identify hazards and describe safe work practices pertaining to low-voltage single-phase transformers.

3. Interpret codes, regulations and standards pertaining to low-voltage single-phase transformers.

4. Interpret information contained on low-voltage single-phase transformer nameplates.

5. Explain the operating principles of low-voltage single-phase transformers.

6. Explain transformer polarity and terminal markings.

7. Identify types of low-voltage single-phase transformers and describe their characteristics and applications.
   i) dry-type
   ii) dielectric liquid-filled
   iii) isolation
   iv) step-down, step-up
   v) auto
   vi) instrument transformer

8. Identify low-voltage single-phase transformer components and describe their characteristics and applications.
    i) ventilation fans
    ii) casings and enclosures
    iii) core
    iv) primary and secondary windings
    v) bushings
    vi) on-line and off-line (on-load and off-load) tap changers
    vii) insulating oil/dielectric liquid
    viii) oil pumps

9. Identify considerations and requirements for selecting low-voltage single-phase transformers.

10. Identify tools and equipment used to install, service and maintain low-voltage single-phase transformers and describe their applications and procedures for use.

11. Describe the procedures used to install low-voltage single-phase transformers.

12. Describe the procedures used to install low-voltage single-phase transformers in parallel.

13. Describe the procedures used to ground low-voltage transformers.

14. Describe the procedures used to service low-voltage single-phase transformers and their components.

15. Describe the procedures used to maintain low-voltage single-phase transformers and their components.

Practical Objectives:

N/A

ELE-260 Renewable Energy and Storage Systems I

Learning Outcomes:

- Demonstrate knowledge of renewable energy generating systems, their applications and basic operation.
- Demonstrate knowledge of procedures to connect renewable energy generating systems and control system components.

IEL 2021 Red Seal Occupational Standard Reference:

13.01 Installs renewable energy generating and energy storage systems.

Suggested Hours:

9 Hours

Theoretical Objectives:

1. Define terminology associated with renewable energy generating systems.

2. Identify hazards and describe safe work practices pertaining to renewable energy generating systems.

3. Identify standards pertaining to renewable energy.
   i) Canadian Net-Zero Emissions Accountability Act (CNZEAA)
   ii) Leadership in Energy and Environmental Design (LEED)

4. Interpret codes, regulations and standards pertaining to renewable energy generating systems.
   i) Local supply authority having jurisdiction bulletins

5. Identify types of renewable energy generating systems and describe their characteristics, applications and operation.
   i) wind turbines
   ii) photovoltaic systems

6. Identify renewable energy generating system components and describe their purpose and operation.

7. Identify tools and equipment used to connect renewable energy generating systems and describe their applications and procedures for use.

8. Describe the procedures used to ground renewable energy generating systems and their components.

9. Describe the procedures used to connect renewable energy generating systems and control system components.

10. Identify electronic components and describe their application as it pertains to renewable energy generating and storage systems.

Practical Objectives:

N/A

ELE-265 Exit and Emergency Lighting Systems

Learning Outcomes:

- Demonstrate knowledge of exit and emergency lighting systems, their applications and operation.
- Demonstrate knowledge of procedures to remove and/or install, exit and emergency lighting systems and their components.
- Demonstrate knowledge of procedures to service exit and emergency lighting systems.
- Demonstrate knowledge of procedures to maintain exit and emergency lighting systems.

IEL 2021 Red Seal Occupational Standard Reference:

20.01 Installs exit and emergency lighting systems.
20.02 Maintains exit and emergency lighting systems.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with exit and emergency lighting systems.

2. Interpret codes, regulations and standards pertaining to exit and emergency lighting systems.
   i) Canadian Electrical Code (CEC)
   ii) National Building Code of Canada (NBC)

3. Interpret information pertaining to exit and emergency lighting systems found on drawings and specifications.

4. Identify types of exit and emergency lighting systems and describe their characteristics, applications and operation.
   i) unit equipment
   ii) central-powered
   iii) remote lighting units
   iv) automatic emergency power transfer control relays

5. Identify exit and emergency lighting system components and describe their characteristics and applications.

6. Identify considerations and requirements for removal and disposal of exit and emergency lighting systems and their components.

7. Identify considerations and requirements for selecting exit and emergency lighting systems and their components.

8. Identify tools and equipment used to install, service and maintain exit and emergency lighting systems and describe their applications and procedures for use.

9. Describe the procedures used to remove exit and emergency lighting systems and their components.

10. Describe the procedures used to install exit and emergency lighting systems and their components.

11. Describe the procedures used to test exit and emergency lighting systems and their components and complete the required documentation.

12. Describe the procedures used to diagnose exit and emergency lighting systems and their components.

13. Describe the procedures used to repair/replace exit and emergency lighting systems and their components.

14. Describe the procedures used to maintain exit and emergency lighting systems and their components.

15. Identify electronic components and describe their application as it pertains to exit and emergency lighting systems.

Practical Objectives:

N/A

ELE-270 Heating, Ventilation and Air-Conditioning Systems

Learning Outcomes:

- Demonstrate knowledge of heating, ventilation and air-conditioning (HVAC) systems, their applications and operation.
- Demonstrate knowledge of procedures to disconnect and connect HVAC systems and associated equipment.
- Demonstrate knowledge of procedures to service and maintain electrical components of HVAC systems and associated equipment.

IEL 2021 Red Seal Occupational Standard Reference:

18.01 Connects power to HVAC systems and associated equipment.
18.03 Maintains HVAC electrical components.

Suggested Hours:

15 Hours

Theoretical Objectives:

1. Define terminology associated with HVAC systems.

2. Identify hazards and describe safe work practices pertaining to HVAC systems.

3. Interpret codes, regulations and standards pertaining to HVAC systems.

4. Interpret information pertaining to HVAC systems found on drawings and specifications.

5. Explain the principles of heat transfer.
   i) radiation
   ii) conduction
   iii) convection

6. Identify types of HVAC systems and describe their characteristics and applications.
   i) heat pumps
   ii) boilers
   iii) furnace
   iv) compressor unit
   v) fan motor
   vi) chiller systems
   vii) cooling tower heater

7. Identify considerations and requirements for disconnecting electrical components of HVAC systems and associated equipment.

8. Identify considerations and requirements for connecting electrical components of HVAC systems and associated equipment.

9. Identify tools and equipment used to connect, service and maintain electrical components of HVAC systems and describe their applications and procedures for use.

10. Describe the procedures used to connect electrical components of HVAC systems and associated equipment.

11. Describe the procedures used to disconnect electrical components of HVAC systems and associated equipment.

12. Describe the procedures used to diagnose electrical components of HVAC systems and associated equipment.

13. Describe the procedures used to repair electrical components of HVAC systems and associated equipment.

14. Describe the procedures used to maintain electrical components of HVAC systems and associated.

15. Identify electronic components and describe their application as it pertains to HVAC systems.

Practical Objectives:

N/A

ELE-275 Heating, Ventilation and Air-Conditioning System Controls

Learning Outcomes:

- Demonstrate knowledge of heating, ventilation and air-conditioning (HVAC) control components, their applications and operation.
- Demonstrate knowledge of procedures to install HVAC control components.
- Demonstrate knowledge of procedures to service and maintain HVAC control components.

IEL 2021 Red Seal Occupational Standard Reference:

18.02 Installs HVAC controls.
18.03 Maintains HVAC electrical components.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with HVAC controls.

2. Identify hazards and describe safe work practices pertaining to HVAC controls.

3. Interpret codes, regulations and standards pertaining to HVAC control components.

4. Interpret information pertaining to HVAC control components found on drawings and specifications.

5. Identify types of HVAC control components and describe their characteristics and applications.
   i) thermostats
   ii) switches (pressure, temperature, flow, level)
   iii) time clocks
   iv) relays
   v) sensors
   vi) actuators
   vii) electrical interlocks
   viii) multiple function controllers
   ix) variable frequency drives (VFDs)

6. Identify tools and equipment used to install, service and maintain HVAC controls and describe their applications and procedures for use.

7. Identify considerations and requirements for removal of HVAC control components.

8. Identify considerations and requirements for selecting HVAC control components.

9. Describe the procedures used to remove HVAC control components.

10. Describe the procedures used to install HVAC control components.

11. Describe the procedures used to connect HVAC control components.

12. Describe the procedures used to test HVAC control components.

13. Describe the procedures used to diagnose HVAC controls and their components.

14. Describe the procedures used to repair HVAC controls and their components.

15. Describe the procedures used to maintain HVAC controls and their components.

16. Identify electronic components and describe their application as it pertains to HVAC system controls.

Practical Objectives:

N/A

ELE-280 Electric Heating Systems

Learning Outcomes:

- Demonstrate knowledge of electric heating systems, their applications and operation.
- Demonstrate knowledge of procedures to remove and/or install electric heating systems.
- Demonstrate knowledge of procedures to service electric heating systems.
- Demonstrate knowledge of procedures to maintain electric heating systems.

IEL 2021 Red Seal Occupational Standard Reference:

19.01 Installs electric heating systems and controls.
19.02 Maintains electric heating systems and controls.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with electric heating systems.

2. Identify hazards and describe safe work practices pertaining to electric heating systems.

3. Interpret codes, regulations and standards pertaining to electric heating systems.

4. Interpret information pertaining to electric heating systems found on drawings and specifications.

5. Identify types of electric heating systems and describe their applications and operation.
   i) electric forced air furnace
   ii) electric boilers
   iii) convection heaters
   iv) radiant heaters
   v) heat tracing cables
   vi) duct heaters
   vii) Induction heating
   viii) heating cables

6. Identify types of domestic water heating systems and describe their applications and operation.
   i) electric tank water heaters
   ii) electric tankless water heaters

7. Identify electric heating system components and describe their characteristics and applications.

8. Identify tools and equipment used to install, service and maintain electric heating systems and describe their applications and procedures for use.

9. Identify considerations and requirements for removal of electric heating systems and their components.

10. Identify considerations and requirements for selecting electric heating systems and their components.

11. Describe factors that contribute to basic heat loss.

12. Perform calculations to determine heating requirements.

13. Describe the procedures used to remove electric heating systems and their components.

14. Describe the procedures used to install electric heating systems and their components.

15. Describe the procedures used to diagnose electric heating systems.

16. Describe the procedures used to repair electric heating systems.

17. Describe the procedures used to maintain electric heating systems.

18. Identify electronic components and describe their application as it pertains to electric heating systems.

Practical Objectives:

N/A

ELE-285 Electric Heating System Controls

Learning Outcomes:

- Demonstrate knowledge of types of electric heating system control components, their applications and operation.
- Demonstrate knowledge of procedures to remove and/or install electric heating system control components.
- Demonstrate knowledge of procedures to service electric heating system control components.
- Demonstrate knowledge of procedures to maintain electric heating system control components.

IEL 2021 Red Seal Occupational Standard Reference:

19.01 Installs electric heating systems and controls.
19.02 Maintains electric heating systems and controls.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with electric heating system controls.

2. Identify hazards and describe safe work practices pertaining to electric heating system controls.

3. Interpret codes, regulations and standards pertaining to electric heating system control components.

4. Interpret information pertaining to electric heating system control components found on drawings and specifications.

5. Identify types of electric heating system control components and describe their characteristics and applications.
   i) thermostats
   ii) heating relays
   iii) sensors
   iv) contactors
   v) electrical interlocks
   vi) semiconductor controls
   vii) web-based controls

viii) automated controls
ix) smart controls

6. Identify considerations and requirements for removal of electric heating system control components.

7. Identify considerations and requirements for selecting electric heating system control components.

8. Identify tools and equipment used to install, service and maintain electric heating system control components.

9. Describe the procedures used to remove electric heating system control components.

10. Describe the procedures used to install electric heating system control components.

11. Describe the procedures used to connect electric heating system control components.

12. Describe the procedures used to test electric heating system control components.

13. Describe the procedures used to diagnose electric heating system control components.

14. Describe the procedures used to repair electric heating system control components.

15. Describe the procedures used to maintain electric heating system control components.

16. Identify electronic components and describe their application as it pertains to electric heating system controls.

Practical Objectives:

N/A

ELE-290 Cathodic Protection Systems

Learning Outcomes:

- Demonstrate knowledge of cathodic protection systems, their applications and operation.
- Demonstrate knowledge of procedures to install, connect and test cathodic protection systems.
- Demonstrate knowledge of procedures to service and maintain cathodic protection systems.

IEL 2021 Red Seal Occupational Standard Reference:

21.01 Installs cathodic protection systems.
21.02 Maintains cathodic protection systems.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with cathodic protection systems.

2. Identify hazards and describe safe work practices pertaining to cathodic protection systems.

3. Interpret codes, regulations and standards pertaining to cathodic protection systems.

4. Interpret information pertaining to cathodic protection systems found on drawings and specifications.

5. Identify types of cathodic protection systems and describe their characteristics, applications and operation.
   i) active rectifier
   ii) sacrificial anode

6. Identify cathodic protection system components and describe their characteristics, applications and operation.
   i) rectifier
   ii) insulating kits
   iii) cabling
   iv) breaker
   v) anode connection cable

vi) remote reference points
vii) tap settings in the rectifier enclosure

7. Identify tools and equipment used to install, service and maintain cathodic protection systems and describe their applications and procedures for use.

8. Describe the procedures used to install and connect cathodic protection systems and their components.

9. Describe the procedures used to test cathodic protection systems and their components.

10. Describe the procedures used to diagnose and repair cathodic protection systems.

11. Describe the procedures used to maintain cathodic protection systems.

12. Identify electronic components and describe their application as it pertains to cathodic protection systems.

Practical Objectives:

N/A

ELE-295 DC Motors I

Learning Outcomes:

- Demonstrate knowledge of DC motors, their applications and operation.

IEL 2021 Red Seal Occupational Standard Reference:

25.05 Installs direct current (DC) motors.
25.06 Maintains direct current (DC) motors.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Interpret information contained on motor nameplates.

2. Explain the operating principles of DC motors.

3. Identify types of DC motors and describe their characteristics, applications and operation.
   i) self-excited
   ii) separately excited
   iii) series
   iv) shunt
   v) compound

4. Identify DC motor components and describe their purpose and operation.
   i) frame
   ii) armature
   iii) rotor
   iv) stator
   v) commutator
   vi) end bells
   vii) yoke
   viii) fans
   ix) brushes
   x) bearings
   xi) bushings

5. Identify considerations and requirements for selecting DC motors and controls and their components.

Practical Objectives:

N/A

ELE-296 Motor Starters I

Learning Outcomes:

- Demonstrate knowledge of single-phase motor starters and controllers, their applications and operation.
- Demonstrate knowledge of procedures to install single-phase motor starters and controllers.
- Demonstrate knowledge of procedures to service and maintain single-phase motor starters and controllers.

IEL 2021 Red Seal Occupational Standard Reference:

22.01 Installs motor starters.
22.02 Maintains motor starters.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with single-phase motor starters.

2. Identify hazards and describe safe work practices pertaining to single-phase motor starters.

3. Interpret codes, regulations and standards pertaining to single-phase motor starters.

4. Interpret information pertaining to single-phase motor starters found on drawings and specifications.

5. Interpret information contained on motor nameplates.

6. Identify types of single-phase motor starters and describe their characteristics and applications.
   i) manual
   ii) magnetic

7. Describe starting methods and their applications.
   i) full voltage

8. Identify tools and equipment used to install single-phase motor starters and describe their applications and procedures for use.

9. Describe the procedures used to install single-phase motor starters and their components and accessories.
   i) manual
   ii) magnetic

10. Describe the procedures used to connect single-phase motor starters and their components and accessories.

11. Identify enclosures and wiring methods based on application.

12. Describe the procedures used to service single-phase motor starters, their components and accessories.

13. Describe the procedures used to maintain single-phase motor starters, their components and accessories.

Practical Objectives:

N/A

ELE-297 Motor Control Devices I

Learning Outcomes:

- Demonstrate knowledge of basic motor control devices, their applications and operation.
- Demonstrate knowledge of basic motor control circuits, their characteristics and applications.
- Demonstrate knowledge of procedures to service and maintain motor basic control devices.

IEL 2021 Red Seal Occupational Standard Reference:

22.03 Installs motor control devices.
22.04 Maintains motor control devices.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with basic motor control devices.

2. Identify hazards and describe safe work practices pertaining to motor control devices.

3. Interpret codes, regulations and standards pertaining to basic motor control circuits and devices.

4. Interpret information pertaining to basic motor control devices found on drawings and specifications.

5. Describe basic motor control devices, their applications and operation.
   i) emergency stop stations
   ii) start/stop stations

6. Identify motor control circuit types and describe their characteristics and applications.
   i) low voltage release (two wire control)
   ii) low voltage protection (three wire control)

7. Describe circuit functional features of basic hard wired motor control circuits.
   i) starting and stopping
   ii) jogging

8. Identify methods used to determine the number of conductors required between basic controls and controller locations.

9. Identify tools and equipment used to service and maintain motor control devices and describe their applications and procedures for use.

10. Describe the procedures used to service basic motor control devices and their components.

11. Describe the procedures used to maintain basic motor control devices and their components.

Practical Objectives:

N/A

ELE-298 Drawings, Schematics and Specifications II

Learning Outcomes:

- Demonstrate knowledge of advanced drawings, schematics and specifications.
- Demonstrate knowledge of interpreting and extracting information from advanced drawings, schematics and specifications.
- Demonstrate knowledge of procedures and requirements to document changes to equipment and wiring.

IEL 2021 National Occupational Analysis Reference:

3.01 Uses plans, schematics, drawings and specifications.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Identify types of advanced drawings, schematics and specifications and describe their applications.
   - i) single-line distribution system layout drawings
   - ii) riser diagrams
   - iii) equipment schedules
   - iv) project documentation
   - v) interference drawings

2. Interpret and extract information from advanced drawings, schematics and specifications.

3. Interpret and extract information from key diagrams used on drawings.

4. Identify documentation requirements for modifying drawings and specifications.

5. Describe the procedures used to document changes made to equipment and wiring.

Practical Objectives:

N/A

ELE-299 Lightning Protection Systems

Learning Outcomes:

- Demonstrate knowledge of lightning protection systems, their applications and operation.
- Demonstrate knowledge of procedures to install lightning protection systems.
- Demonstrate knowledge of procedures to service and maintain lightning protection systems.

IEL 2021 Red Seal Occupational Standard Reference:

8.03 Installs ground fault, arc fault and surge protection devices

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with lightning protection systems.

2. Identify hazards and describe safe work practices pertaining to lightning protection systems.

3. Interpret codes, regulations and standards pertaining to lightning protection systems.

4. Interpret information pertaining to lightning protection systems found on drawings and specifications.

5. Identify types of lightning protection systems and describe their characteristics, applications and operation.
   i) lightning arrester protection
   ii) structure protection

6. Identify lightning protection system components and describe their purpose and operation.
   i) lightning rod (air terminal)
   ii) intercepting conductors
   iii) down conductors
   iv) ground electrodes (ground rods)
      - off-grid
      - grid-tie
   v) supports

vi) lightning arresters

7. Explain the purpose of lightning protection systems.

8. Identify considerations and requirements for selecting the type of lightning protection systems.

9. Identify tools and equipment used to install, service and maintain lightning protection systems and describe their applications and procedures for use.

10. Describe the procedures used to install lightning protection systems and their components.

11. Describe the procedures used to service lightning protection systems and their components.

12. Describe the procedures used to maintain lightning protection systems and their components.

Practical Objectives:

N/A

Level 3

ELE-320 Three-Phase Theory

Learning Outcomes:

- Demonstrate knowledge of three-phase electricity, its characteristics and associated principles.
- Demonstrate knowledge of three-phase electricity calculations.

IEL 2021 Red Seal Occupational Standard Reference:

N/A

Suggested Hours:

30 Hours

Theoretical Objectives:

1. Define terminology associated with three-phase theory.

2. Identify hazards and describe safe work practices pertaining to three-phase electricity.

3. Identify units of measure and symbols pertaining to three-phase electricity.

4. Explain three-phase power generation.

5. Identify types of three-phase connections and describe their characteristics and applications.
   i) delta
   ii) wye

6. Explain voltage and current relations in three-phase connections.
   i) vector analysis

7. Identify tools and equipment used to measure three-phase electricity and describe their applications and procedures for use.

8. Describe the procedures used to measure three-phase electricity.

9. Perform calculations for balanced and unbalanced loads.
10. Perform calculations pertaining to three-phase electricity.
    i) true power
    ii) apparent power
    iii) reactive power

iv) power factor

Practical Objectives:

N/A

ELE-325 Ground Fault Protection and Detection Systems I

Learning Outcomes:

- Demonstrate knowledge of ground fault protection and detection systems, their applications and operation.
- Demonstrate knowledge of procedures to install ground fault protection and detection systems.

IEL 2021 Red Seal Occupational Standard Reference:

11.05 Installs ground-fault protection and detection systems.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with ground fault systems.

2. Interpret codes, regulations and standards pertaining to ground fault systems.

3. Interpret information pertaining to ground fault systems found on drawings and specifications.

4. Identify types of ground fault systems and describe their characteristics and applications.
   i) ground fault protection (solidly grounded systems)
   ii) ground fault detection (ungrounded systems, impedance grounded, mobile equipment)

5. Explain the purpose of ground fault systems.

6. Identify considerations and requirements for selecting ground fault system components.
   i) CTs
   ii) VTs
   iii) resistors
   iv) relays
   v) annunciators (horns, panels)
   vi) indicators (pilot lights)
   vii) reset buttons
   viii) breakers
   ix) interconnecting wiring

x) ground fault sensors (direct, residual or zero sequence)
xi) meters

7. Identify tools and equipment used to install ground fault protection and detection systems and describe their applications and procedures for use.

8. Describe the procedures used to install ground fault protection and detection systems and their components.

9. Identify electronic components and describe their application as it pertains to ground fault protection and detection systems.

Practical Objectives:

N/A

ELE-330 Three-Phase Services

Learning Outcomes:

- Demonstrate knowledge of three-phase services and their applications.
- Demonstrate knowledge of procedures to install three-phase services.
- Demonstrate knowledge of procedures to service and maintain three-phase services.
- Demonstrate knowledge of load calculations for three-phase services.

IEL 2021 Red Seal Occupational Standard Reference:

7.03 Installs three-phase utility and non-utility supply services and metering equipment.
7.04 Maintains three-phase utility and non-utility supply services and metering equipment.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with three-phase services.

2. Identify hazards and describe safe work practices pertaining to three-phase services.

3. Interpret codes, regulations and standards pertaining to three-phase services.

4. Interpret information pertaining to three-phase services found on drawings and specifications.

5. Identify sources of information and documentation required for the installation of three-phase services.

6. Identify types of three-phase services and describe their characteristics and applications.
   i) temporary service
   ii) overhead
   iii) underground
   iv) single and multiple metering

7. Identify three-phase service components, service conductors and fasteners and describe their purpose and applications.

8. Identify considerations and requirements for selecting three-phase services, service components, service conductors and metering equipment.

9. Identify tools and equipment used to install, service and maintain three-phase services and describe their applications and procedures for use.

10. Describe the procedures used to install three-phase services, service components and service conductors.

11. Describe the procedures used to connect service conductors.

12. Describe the procedures used to ground and bond three-phase services.

13. Perform load calculations.
    i) balanced
    ii) un-balanced

14. Describe the procedures used to service three-phase services and their components.

15. Describe the procedures used to maintain three-phase services and their components.

Practical Objectives:

N/A

ELE-335 Three-Phase Power Distribution Equipment

Learning Outcomes:

- Demonstrate knowledge of three-phase power distribution equipment, their applications and operation.
- Demonstrate knowledge of procedures to install three-phase power distribution equipment.
- Demonstrate knowledge of calculations for three-phase power distribution equipment ratings.
- Demonstrate knowledge of procedures to service and maintain three-phase power distribution equipment.
- Demonstrate knowledge of procedures to commission, start up, shut down, and decommission three-phase power distribution equipment.

IEL 2021 Red Seal Occupational Standard Reference:

9.01 Installs low-voltage distribution equipment.
9.02 Maintains low-voltage distribution equipment.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with three-phase power distribution equipment.

2. Identify hazards and describe safe work practices pertaining to three-phase power distribution equipment.

3. Interpret codes, regulations and standards pertaining to three-phase power distribution equipment.

4. Interpret information pertaining to three-phase power distribution equipment found on drawings and specifications.

5. Identify types of three-phase power distribution equipment and describe their characteristics, applications and operation.
   i) panels
   ii) sub-panels
   iii) power distribution centres (PDC)
   iv) switchboards
   v) breakers

vi) fuses
vii) disconnects
viii) racking equipment
ix) CTs
x) VTs
xi) busbars
xii) splitters
xiii) motor control centres (MCC)

6. Identify considerations and requirements for selecting three-phase power distribution equipment and enclosures.
   i) load
   ii) voltage ratings
   iii) required circuit capacity/amperage ratings

7. Identify tools and equipment used to install, service and maintain three-phase power distribution equipment and describe their applications and procedures for use.

8. Describe the procedures used to install three-phase power distribution equipment.

9. Describe the procedures used to connect three-phase power distribution equipment.

10. Describe the procedures used to transport and move three-phase power distribution equipment.

11. Perform calculations to determine three-phase distribution equipment ratings.
   i) panels/sub-panels
   ii) disconnects
   iii) overcurrent devices

12. Describe the procedures used to service three-phase power distribution equipment and their components.

13. Describe the procedures used to maintain three-phase power distribution equipment and their components.

14. Identify electronic components and describe their application as it pertains to three-phase power distribution equipment.

Practical Objectives:

N/A

ELE-340 AC Generating Systems

Learning Outcomes:

- Demonstrate knowledge of AC generating systems, their applications and operation.
- Demonstrate knowledge of procedures to install and connect AC generating systems.
- Demonstrate knowledge of procedures to service and maintain AC generating systems.

IEL 2021 Red Seal Occupational Standard Reference:

11.01 Installs grounding systems.
11.03 Installs bonding systems.
12.01 Installs alternating current (AC) generating systems.
12.02 Maintains AC generating systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with AC generating systems.

2. Identify hazards and describe safe work practices pertaining to AC generating systems.

3. Interpret codes, standards and regulations pertaining to AC generating systems.

4. Interpret information pertaining to AC generating systems found on drawings and specifications.

5. Identify types of AC generating systems and describe their characteristics, applications and operation.
   i) single-phase
   ii) three-phase
   iii) portable
   iv) stationary
   v) manually operated
   vi) automatically operated

6. Identify AC generating system components and describe their purpose and operation.

7. Identify considerations and requirements for selecting AC generating systems and their components.

8. Identify tools and equipment used to install, service and maintain AC generating systems and describe their applications and procedures for use.

9. Describe the procedures used to install AC generating systems and their components.

10. Describe the procedures used to connect AC generating systems and AC generating system components.
    i) floating ground

11. Describe the procedures used to interconnect and synchronize AC generating systems with stand-alone or parallel operations.

12. Describe the procedures used to control the output voltage, phase sequencing and frequency of AC generators.

13. Describe the procedures used to service AC generating systems and their components.

14. Describe the procedures used to maintain AC generating systems and their components.

15. Identify electronic components and describe their application as it pertains to AC generating systems.

16. Identify methods of grounding and bonding AC generating systems.

Practical Objectives:

N/A

ELE-345 Low-Voltage Three-Phase Transformers

Learning Outcomes:

- Demonstrate knowledge of low-voltage three-phase transformers, their applications and operation.
- Demonstrate knowledge of procedures to install low-voltage three-phase transformers.
- Demonstrate knowledge of procedures to service and maintain low-voltage three-phase transformers.

IEL 2021 Red Seal Occupational Standard Reference:

15.05 Installs low voltage three-phase transformers.
15.06 Maintains low voltage three-phase transformers.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with low-voltage three-phase transformers.

2. Identify hazards and describe safe work practices pertaining to low-voltage three-phase transformers.

3. Interpret codes, regulations and standards pertaining to low-voltage three-phase transformers.

4. Interpret information contained on low-voltage three-phase transformer nameplates.

5. Explain the operating principles of low-voltage three-phase transformers.

6. Explain transformer polarity and terminal markings.

7. Identify the characteristics of low-voltage three-phase transformers.
   i) wye
   ii) delta
   iii) impedance
   iv) core type
   v) isolation
   vi) step-down
   vii) step-up
   viii) auto

ix) toroidal

8. Identify types of low-voltage three-phase transformers and describe their applications.
   i) dry-type
   ii) dielectric liquid-filled

9. Identify low-voltage three-phase transformer components and describe their characteristics and applications.
   i) ventilation fans
   ii) casings and enclosures
   iii) core
   iv) primary and secondary windings
   v) oil pumps
   vi) bushings
   vii) on-line/off-line (on-load/off-load) manual and automatic tap changers

10. Identify winding configurations for low-voltage three-phase transformers.
   i) wye-wye
   ii) open-wye
   iii) wye-delta
   iv) delta-wye
   v) open-delta
   vi) delta-delta
   vii) zig-zag
   viii) Scott connection

11. Identify considerations and requirements for selecting low-voltage three-phase transformers.

12. Identify tools and equipment used to install, service and maintain low-voltage three-phase transformers and describe their applications and procedures for use.

13. Describe the procedures used to install low-voltage three-phase transformers.

14. Describe the procedures used to install low-voltage three-phase transformers in parallel.

15. Describe the procedures used to ground low-voltage three-phase transformers.

16. Describe the procedures used to test low-voltage three-phase transformers.
17. Describe the procedures used to service low-voltage three-phase transformers and their components.

18. Describe the procedures used to maintain low-voltage three-phase transformers and their components.

Practical Objectives:

1. Install, connect, and test a low-voltage three-phase transformer.

ELE-350 High-Voltage Transformers

Learning Outcomes:

- Demonstrate knowledge of high-voltage transformers, their applications and operation.
- Demonstrate knowledge of procedures to install high-voltage transformers.
- Demonstrate knowledge of procedures to service and maintain high-voltage transformers.

IEL 2021 Red Seal Occupational Standard Reference:

15.07 Installs high-voltage transformers.
15.08 Maintains high-voltage transformers.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with high-voltage transformers.

2. Identify hazards and describe safe work practices pertaining to high-voltage transformers.

3. Interpret information contained on high-voltage transformer nameplates.

4. Interpret codes, regulations and standards pertaining to high-voltage transformers.

5. Explain the operating principles of high-voltage transformers.

6. Explain transformer polarity and terminal markings.

7. Identify types of high-voltage transformers and describe their characteristics and applications.
   i) dry-type
   ii) dielectric liquid-filled

8. Identify high-voltage transformer components and describe their characteristics and applications.
   i) oil pumps
   ii) ventilation fans
   iii) casing
   iv) core

v) primary windings
vi) secondary windings
vii) desiccant breather
viii) gas detection (buchholz) relay
ix) bushings
x) on-line (on-load) tap changers
xi) off-line (off-load) tap changers
xii) oil
xiii) monitoring devices

9. Identify winding configurations for high-voltage transformers.
   i) wye-wye
   ii) open-wye
   iii) wye-delta
   iv) delta-wye
   v) open-delta
   vi) delta-delta
   vii) zig-zag

10. Identify considerations and requirements for selecting high-voltage transformers.

11. Identify tools and equipment used to install, service and maintain high-voltage transformers and describe their applications and procedures for use.

12. Describe the procedures used to install high-voltage transformers.

13. Describe the procedures used to ground high-voltage transformers.

14. Describe the procedures used to install high-voltage transformers in parallel.

15. Describe the procedures used to test high-voltage transformers.

16. Describe the procedures used to service high-voltage transformers and their components.

17. Describe the procedures used to maintain high-voltage transformers and their components.

Practical Objectives:

N/A

ELE-355 Motor Starters II

Learning Outcomes:

- Demonstrate knowledge of motor starters and controllers, their applications and operation.
- Demonstrate knowledge of procedures to install motor starters and controllers.
- Demonstrate knowledge of procedures to service and maintain motor starters and controllers.

IEL 2021 Red Seal Occupational Standard Reference:

22.01 Installs motor starters.
22.02 Maintains motor starters.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with motor starters and controllers.

2. Identify hazards and describe safe work practices pertaining to motor starters and controllers.

3. Interpret codes, regulations and standards pertaining to motor starters and controllers.

4. Interpret information pertaining to motor starters found on manufacturers' nameplate data, drawings and specifications.

5. Identify types of motor starters and describe their characteristics and applications.
   i) starters for AC/DC motors
   ii) single-phase
   iii) three-phase AC
   iv) line voltage starters
   v) dual speed starter
   vi) forward/reverse starter
   vii) soft starters
   viii) reduced-voltage starters
   ix) self-protected combination motor controller

6. Describe starting methods and their applications.
   i) full voltage

ii) reduced voltage
- primary resistor
- autotransformer
- wye-delta
- solid state/soft starting

iii) alternative methods
- part winding
- wound rotor starting

7. Identify types of motor control devices and components and describe their characteristics and applications.
   i) wound rotor motor controller
   ii) multi-speed controller
   iii) frequency drives

8. Identify types of motor control centres (MCC) and components and describe their characteristics and applications.

9. Identify tools and equipment used to install, service and maintain motor starters and controllers and describe their applications and procedures for use.

10. Describe the procedures used to install motor starters and controllers and their components and accessories.

11. Describe the procedures used to connect motor starters and controllers and their components and accessories.

12. Describe the procedures used to service motor starters and controllers and their components and accessories.

13. Describe the procedures used to maintain motor starters and controllers and their components and accessories.

14. Identify electronic components and describe their application as it pertains to motor starters.

Practical Objectives:

N/A

ELE-360 Motor Control Devices II

Learning Outcomes:

- Demonstrate knowledge of motor control devices, their applications and operation.
- Demonstrate knowledge of motor control circuits, their characteristics and applications.
- Demonstrate knowledge of procedures to service and maintain motor control devices.

IEL 2021 Red Seal Occupational Standard Reference:

22.04 Maintains motor control devices.

Suggested Hours:

24 Hours

Theoretical Objectives:

1. Define terminology associated with motor control devices and circuits.

2. Identify hazards and describe safe work practices pertaining to motor control devices.

3. Interpret codes, regulations and standards pertaining to motor control circuits and devices.

4. Interpret information pertaining to motor control devices found on drawings and specifications.

5. Describe motor control devices, their applications and operation.
   - i) flow switches
   - ii) push buttons
   - iii) relays
   - iv) limit switches
   - v) proximity switches
   - vi) pressure switches
   - vii) level switches
   - viii) temperature switches
   - ix) counters
   - x) timers
     - on-delay
     - off-delay

6. Identify types of motor control devices and describe their characteristics and applications.

i) PLCs
ii) pilot devices (limit switches proximity switches, float switches, sail switches, photo detectors)

7. Describe circuit functional features of hard-wired motor control circuits.
   i) starting and stopping
   ii) forward/reverse
   iii) sequencing
   iv) jogging
   v) quick stop (plugging/anti-plugging)
   vi) multiple location control
   vii) time functions

8. Identify methods to determine the number of conductors required between controls and controller locations.

9. Identify protection devices for motor control circuits and describe their characteristics and applications.
   i) overcurrent
   ii) overload
   iii) overheating
   iv) phase loss
   v) phase reversal

10. Identify tools and equipment used to service and maintain motor control devices and describe their applications and procedures for use.

11. Describe the procedures used to service motor control devices and their components.

12. Describe the procedures used to maintain motor control devices and their components.

13. Identify electronic components and describe their applications as it pertains to motor control devices.

Practical Objectives:

1. Connect and operate control circuits.

ELE-365 Single-Phase Motors I

Learning Outcomes:

- Demonstrate knowledge of single-phase motors, their applications and operation.
- Demonstrate knowledge of procedures to install and connect single-phase motors.

IEL 2021 Red Seal Occupational Standard Reference:

25.01 Installs single-phase motors.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with single-phase motors.

2. Identify hazards and describe safe work practices pertaining to single-phase motors.

3. Interpret codes, regulations and standards pertaining to single-phase motors.

4. Interpret information pertaining to single-phase motors found on drawings and specifications.

5. Interpret information pertaining to single-phase motors found on motor nameplates.

6. Identify types of single-phase motors and describe their characteristics, applications and operation.
   i) hermetically sealed
   ii) dual capacitor
   iii) capacitor start/induction run
   iv) split phase
   v) universal
   vi) resistance split phase
   vii) permanent split capacitor
   viii) shaded pole

7. Identify single-phase motor components and accessories and describe their applications.
   i) frame
   ii) centrifugal switch
   iii) armature

iv) rotor
v) stator
vi) end bells
vii) yoke
viii) fans
ix) brushes
x) bearings
xi) bushings

8. Explain the construction and operating principles of single-phase motors.

9. Identify coupling methods for single-phase motors and describe their characteristics and applications.
   i) flexible couplings
   ii) fixed couplings
   iii) magnetic couplings
   iv) belts and chains

10. Identify considerations and requirements for selecting single-phase motors and their components.

11. Identify tools and equipment used to install and connect single-phase motors and describe their applications and procedures for use.

12. Describe the procedures used to install single-phase motors.

13. Describe the procedures used to connect single-phase motors.

14. Perform single-phase motor calculations.
   i) overcurrent
   ii) overload
   iii) conductors

Practical Objectives:

1. Connect and operate single-phase motors.

ELE-370 Three-Phase Motors I

Learning Outcomes:

- Demonstrate knowledge of three-phase motors, their applications operation.
- Demonstrate knowledge of procedures to install and connect three-phase motors.

IEL 2021 Red Seal Occupational Standard Reference:

25.03 Installs three-phase motors.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with three-phase motors.

2. Identify hazards and describe safe work practices pertaining to three-phase motors.

3. Interpret codes, regulations and standards pertaining to three-phase motors.

4. Interpret information pertaining to three-phase motors found on drawings and specifications.

5. Interpret information contained on three-phase motor nameplates.

6. Explain the construction and operating principles of three-phase motors.

7. Identify types of three-phase motors and describe their characteristics.
   i) squirrel cage induction
   ii) wound rotor induction
   iii) synchronous

8. Identify three-phase motor components and describe their applications.

9. Identify coupling methods for three-phase motors and describe their characteristics and applications.
   i) flexible couplings
   ii) fixed couplings
   iii) magnetic couplings
   iv) belts and chains

10. Identify considerations and requirements for selecting three-phase motors and their components.

11. Identify tools and equipment used to install and connect three-phase motors and describe their applications and procedures for use.

12. Describe the procedures used to install three-phase motors.

13. Describe the procedures used to connect three-phase motors.

14. Perform three phase motor calculations.
    i) overcurrent
    ii) overload
    iii) conductors

Practical Objectives:

1. Connect and operate three-phase motors.

ELE-375 DC Motors II

Learning Outcomes:

- Demonstrate knowledge of DC motors, their applications and procedures for use.
- Demonstrate knowledge of procedures to install and connect DC motors.

IEL 2021 Red Seal Occupational Standard Reference:

25.05 Installs direct current (DC) motors.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with DC motors.

2. Identify hazards and describe safe work practices pertaining to DC motors.

3. Interpret codes, regulations and standards pertaining to DC motors.

4. Interpret information pertaining to DC motors found on drawings and specifications.

5. Interpret information contained on motor nameplates.

6. Identify tools and equipment used to install DC motors and controls and their components and describe their applications and procedures for use.

7. Describe the procedures used to install DC motors and their components.

8. Describe the procedures used to connect DC motors and their components.

9. Perform DC motor calculations.
   i) overcurrent
   ii) overload
   iii) conductors

Practical Objectives:

1. Connect and operate DC motors.

ELE-380 AC Drives

Learning Outcomes:

- Demonstrate knowledge of AC drives, their applications and operation.
- Demonstrate knowledge of procedures to install and connect AC drives.
- Demonstrate knowledge of procedures to service and maintain AC drives.

IEL 2021 Red Seal Occupational Standard Reference:

23.01 Installs alternating current (AC) drives.
23.02 Maintains alternating current (AC) drives.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Interpret codes, regulations and standards pertaining to AC drives.

2. Interpret information pertaining to AC drives found on drawings and specifications.

3. Identify types of AC drives and describe their characteristics, applications and operation.

4. Identify AC drive components and accessories and describe their characteristics, applications and operation.
   i) rectifiers
   ii) electro-magnetic compatibility (EMC) filters
   iii) DC circuits
   iv) shielded cables
   v) inverters
   vi) reactors
   vii) field components (encoders, tachometers)

5. Explain the operating principles of AC drives and their impact on motor performance.

6. Identify considerations and requirements for selecting AC drives, their components and accessories.
7. Identify tools and equipment used to install, service and maintain AC drives and describe their applications and procedures for use.

8. Describe the procedures used to install AC drives, their components and accessories.

9. Describe the procedures used to connect AC drives, their components and accessories.

10. Describe the procedures used to adjust AC drives, their components and accessories.

11. Describe the procedures used to service and maintain AC drives, their components and accessories.

12. Identify electronic components and describe their application as it pertains to AC drives.

Practical Objectives:

1. Connect, adjust, and operate AC drives.

ELE-385 DC Drives

Learning Outcomes:

- Demonstrate knowledge of DC drives, their applications and operation.
- Demonstrate knowledge of procedures to install and connect DC drives.
- Demonstrate knowledge of procedures to service and maintain DC drives.

IEL 2021 Red Seal Occupational Standard Reference:

23.03 Installs direct current (DC) drives.
23.04 Maintains direct current (DC) drives.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with DC drives.

2. Identify hazards and describe safe work practices pertaining to DC drives.

3. Interpret codes, regulations and standards pertaining to DC drives.

4. Interpret information pertaining to DC drives found on drawings and specifications.

5. Identify types of DC drives and describe their characteristics, applications and operation.

6. Identify DC drive components and accessories and describe their characteristics, applications and operation.
   i) converters
   ii) regulators

7. Explain the operating principles of DC drives and their impact on motor performance.

8. Identify considerations and requirements for selecting DC drives, their components and accessories.

9. Identify tools and equipment used to install, service and maintain DC drives and describe their applications and procedures for use.

10. Describe the procedures used to install DC drives, their components and accessories.

11. Describe the procedures used to connect DC drives, their components and accessories.

12. Describe the procedures used to configure DC drives, their components and accessories.

13. Describe the procedures used to service and maintain DC drives, their components and accessories.

14. Identify electronic components and describe their application as it pertains to DC drives.

Practical Objectives:

N/A

Level 4

MENT-701 Mentoring II

Learning Outcomes:

- Demonstrate knowledge of effective communication practices as a mentor.
- Demonstrate knowledge of strategies for teaching workplace skills.

IEL 2021 Red Seal Occupational Standard Reference:

6.01 Uses communication techniques.
6.02 Uses mentoring techniques.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Identify the different roles played by a workplace mentor.

2. Identify strategies to create a supportive learning environment.

3. Identify techniques for effective communication as a mentor.
   i) constructive feedback
   ii) active listening
   iii) leading meetings and one-on-one sessions

4. Describe the steps in teaching a skill.
   i) identifying the point of lesson
   ii) linking the lesson
   iii) demonstrating the skill
   iv) providing practice
   v) giving feedback
   vi) assessing skill and progress

5. Identify strategies to assist in teaching a skill while meeting individual learning needs.
   i) principles of instruction
   ii) coaching skills

6. Explain how to adjust a lesson for various situations.

Practical Objectives:

N/A

IEL-405 Ground Fault Protection and Detection Systems II

Learning Outcomes:

- Demonstrate knowledge of procedures to maintain ground fault protection and detection systems.

IEL 2021 Red Seal Occupational Standard Reference:

11.06 Maintains ground-fault protection and detection systems.

Suggested Hours:

3 Hours

Theoretical Objectives:

1. Identify hazards and describe safe work practices pertaining to the maintenance of ground fault protection and detection device systems.

2. Interpret codes, regulations and standards pertaining to ground fault protection and detection systems.

3. Interpret information pertaining to ground fault protection and detection systems found on drawings and specifications.

4. Identify tools and equipment used to maintain ground fault protection and detection systems and describe their application and procedures for use.

5. Describe the procedures used to maintain ground fault protection and detection systems and their components.

Practical Objectives:

N/A

IEL-410 Power Conditioning, Uninterruptible Power Supply (UPS) and Surge Suppression Systems

Learning Outcomes:

- Demonstrate knowledge of power conditioning, UPS and surge suppression systems and their applications.
- Demonstrate knowledge of procedures to install power conditioning, UPS and surge suppression systems.
- Demonstrate knowledge of procedures to maintain power conditioning, ~~uninterruptible power supply~~ UPS and surge suppression systems.

IEL 2021 Red Seal Occupational Standard Reference:

10.01 Installs power conditioning systems.
10.02 Maintains power conditioning systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with power conditioning, UPS and surge suppression systems.

2. Identify hazards and describe safe work practices with UPS systems when working with batteries, multiple energy sources and capacitors.

3. Interpret codes, regulations and standards pertaining to power conditioning, UPS and surge suppression systems.

4. Interpret information pertaining to power conditioning, UPS and surge suppression systems found on drawings and specifications.

5. Explain power quality and its impact on equipment operation.

6. Explain single-phase and three-phase power factor correction and its associated calculations.

7. Identify types of power factor correction equipment and describe their characteristics, applications and operation.
   i) synchronous condensers (motors)

ii) reactors
iii) capacitors
iv) inverters (renewable energy)

8. Identify equipment used to reduce harmonics in power distribution systems and describe their characteristics, applications and operation.
   i) zero sequence/passive and active filters
   ii) K-rated or zig zag transformers and capacitors

9. Identify types of UPS equipment used in power distribution system conditioning and describe their characteristics, applications and operation.
   i) online
   ii) offline
   iii) online interactive
   iv) maintenance bypass and static bypass
   v) batteries and battery charging systems

10. Identify surge suppression equipment used in power distribution system conditioning and describe their characteristics, applications and operation.
   i) capacitors
   ii) shunt coils and diodes

11. Identify tools and equipment used to install and maintain power conditioning, UPS and surge suppression systems and describe their applications and procedures for use.

12. Describe the procedures used to install power conditioning, UPS and surge suppression systems.

13. Describe the procedures used to maintain power conditioning, UPS and surge suppression systems.

14. Identify electronic components and describe their application as it pertains to power conditioning, UPS and surge suppression systems.

Practical Objectives:

N/A

IEL-415 High-Voltage Equipment

Learning Outcomes:

- Demonstrate knowledge of high-voltage equipment, their applications and operation.
- Demonstrate knowledge of procedures to install high-voltage equipment.
- Demonstrate knowledge of testing procedures.
- Demonstrate knowledge of procedures to maintain high-voltage equipment.

IEL 2021 Red Seal Occupational Standard Reference:

14.01 Installs high-voltage systems.
14.02 Maintains high-voltage systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with high-voltage equipment.

2. Identify hazards and describe safe work practices pertaining to high-voltage breakers and starters.
   i) corona discharge
   ii) ozone gas
   iii) proximity to energized exposed equipment

3. Interpret codes, regulations and standards pertaining to high-voltage equipment.

4. Interpret information pertaining to high-voltage equipment found on drawings and specifications.
   i) as-builts
   ii) schematics (AC, DC)
   iii) shop drawings
   iv) single-line drawings
   v) drive drawings

5. Identify grounding conductors, equipment and components and describe their characteristics and applications.

6. Identify bonding conductors, equipment and components and describe their characteristics and applications.

7. Explain the purpose of grounding grids in relation to step and touch voltages.

8. Explain the function of high-voltage equipment.

9. Identify types of high-voltage equipment and describe their characteristics and applications.
   i) distribution equipment
   ii) contactors
   iii) motor starters
   iv) transformers
   v) MCCs
   vi) capacitors
   vii) reactors
   viii) switches
   ix) disconnects
   x) rectifiers
   xi) reclosers
   xii) VTs
   xiii) CTs
   xiv) isolating and load breaking switches
   xv) transmission
   xvi) breakers
   xvii) protection devices
   xviii) worker protective grounds
   xix) hot sticks

10. Identify tools and equipment used to install and maintain high-voltage equipment and describe their applications and procedures for use.

11. Describe the procedures used to install high-voltage equipment.

12. Describe the procedures used to size and install ground grid and grounding conductors.

13. Describe the procedures used to isolate faults by de-energizing source of energy.

14. Identify types of commissioning tests and describe their applications.
   i) polarity
   ii) ground grid resistance
   iii) hi-pot
   iv) phasing
   v) functionality
   vi) timing
   vii) current injection
   viii) interlocking

ix) ultrasonic detectors
x) thermographic imaging device

15. Describe the procedures used to perform ground resistance testing and commissioning testing of high-voltage equipment.

16. Describe the procedures used to maintain high-voltage equipment.

17. Describe the procedures used to install and remove temporary protective ground equipment.

Practical Objectives:

N/A

IEL-420 High-Voltage Cables

Learning Outcomes:

- Demonstrate knowledge of high-voltage cables, their applications and operation.
- Demonstrate knowledge of procedures to install, splice and terminate high- voltage cables.
- Demonstrate knowledge of testing procedures.
- Demonstrate knowledge of procedures to maintain high-voltage cables.
- Demonstrate knowledge of procedures to install and remove temporary protective ground equipment.

IEL 2021 Red Seal Occupational Standard Reference:

14.01 Installs high-voltage systems.
14.02 Maintains high-voltage systems.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with high-voltage cables.

2. Identify hazards and describe safe work practices pertaining to high-voltage cables.

3. Interpret codes, regulations and standards pertaining to high-voltage cables.

4. Interpret information pertaining to high-voltage cables found on drawings and specifications.

5. Identify types of high-voltage cables and describe their characteristics and applications.
   i) armoured cables (with or without shielded conductor)
   ii) TC cable
   iii) trailing cables
   iv) shielded cables
   v) bus ducts
   vi) cable bus

6. Identify high-voltage cable components and describe their characteristics and applications.
   i) potheads
   ii) stress relief terminations

iii) strapping
iv) bracing
v) splice kits

7. Identify considerations and requirements for selecting high-voltage cables and components.

8. Identify tools and equipment used to install and maintain high-voltage cables and describe their applications and procedures for use.

9. Describe the procedures used to install high-voltage cables.

10. Describe the procedures used to terminate and splice high-voltage cables.

11. Identify and describe testing procedures for high-voltage cables.

12. Describe the procedures used to ground and bond high-voltage cables and their components.

13. Describe the procedures used to maintain high-voltage cables and their components.

14. Describe the procedures used to install and remove temporary protective ground equipment.

Practical Objectives:

N/A

IEL-425 Renewable Energy and Storage Systems II

Learning Outcomes:

- Demonstrate knowledge of renewable energy generating systems, their applications and operation.
- Demonstrate knowledge of renewable energy storage systems, their applications and operation.
- Demonstrate knowledge of procedures to install renewable energy generating and storage systems.
- Demonstrate knowledge of procedures to maintain renewable energy generating and storage systems.

IEL 2021 Red Seal Occupational Standard Reference:

13.01 Installs renewable energy generating and energy storage systems.
13.02 Maintains renewable energy generating and energy storage systems.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with renewable energy systems.

2. Identify hazards and describe safe work practices pertaining to renewable energy systems.

3. Interpret codes, regulations and standards pertaining to renewable energy systems.

4. Interpret information pertaining to renewable energy systems found on drawings and specifications.

5. Identify types of renewable energy generating systems and describe their characteristics, applications and operation.
   i) wind turbines
   ii) photovoltaic modules/solar panels
   iii) hydrokinetic
   iv) geothermal
   v) fuel cells
   vi) hydraulic turbines
   vii) tidal

6. Identify renewable energy generating system components and describe their characteristics, applications and operation.
    i) transfer switches
    ii) sun-tracking systems
    iii) batteries
    iv) charge controller
    v) load bank
    vi) inverters with anti-islanding capability
    vii) isolation disconnects
    viii) protection devices

7. Identify types of renewable energy generating system and component connections.
    i) grid dependent
    ii) grid independent (stand-alone)

8. Identify types of energy storage systems and components and describe their characteristics, applications and operation.
    i) pumped hydro
    ii) compressed air energy storage
    iii) batteries (various technologies)

9. Identify types of energy storage system and component connections.

10. Identify tools and equipment used to install and maintain renewable energy systems and describe their applications and procedures for use.

11. Describe the procedures used to install renewable energy generating and storage systems and components.

12. Describe the procedures used to ground renewable energy generating and storage systems and their components.

13. Describe the procedures used to connect renewable energy generating and storage systems and components.

14. Describe the procedures used to maintain renewable energy generating and storage systems and their components.

15 Identify electronic components and describe their application as it pertains to renewable energy and storage systems.

16. Describe the procedures used to commission, startup, shutdown, and decommission renewable energy and storage systems.

Practical Objectives:

N/A

IEL-430 Single-Phase Motors II

Learning Outcomes:

- Demonstrate knowledge of procedures to maintain single-phase motors.

IEL 2021 Red Seal Occupational Standard Reference:

25.02 Maintains single-phase motors.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Identify hazards and describe safe work practices pertaining to single-phase motors.
2. Interpret codes, regulations and standards pertaining to single-phase motors.
3. Interpret information pertaining to single-phase motors found on drawings and specifications.
4. Identify tools and equipment used to maintain single-phase motors and describe their application and procedures for use.
5. Describe the procedures used to diagnose and test single-phase motors and their components.
6. Describe the procedures used to maintain single-phase motors and their components.

Practical Objectives:

N/A

IEL-435 DC Motors III

Learning Outcomes:

- Demonstrate knowledge of procedures to maintain DC motors.

IEL 2021 Red Seal Occupational Standard Reference:

25.06 Maintains direct current (DC) motors.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Identify hazards and describe safe work practices pertaining to DC motors.

2. Interpret codes, regulations and standards pertaining to DC motors.

3. Interpret information pertaining to DC motors found on drawings and specifications.

4. Identify tools and equipment used to maintain DC motors and describe their application and procedures for use.

5. Describe the procedures used to diagnose and test DC motors and their components.

6. Describe the procedures used to maintain DC motors and their components.

Practical Objectives:

N/A

IEL-440 Three-Phase Motors II

Learning Outcomes:

- Demonstrate knowledge of procedures to maintain three-phase motors.

IEL 2021 Red Seal Occupational Standard Reference:

25.04 Maintains three-phase motors.

Suggested Hours:

9 Hours

Theoretical Objectives:

1. Identify hazards and describe safe work practices pertaining to three-phase motors.

2. Interpret codes, regulations and standards pertaining to three-phase motors.

3. Interpret information pertaining to three-phase motors found on drawings and specifications.

4. Identify tools and equipment used to maintain three-phase motors and describe their application and procedures for use.

5. Describe the procedures used to diagnose and test three-phase motors and their components.

6. Describe the procedures used to maintain three-phase motors and their components.

Practical Objectives:

N/A

IEL-445 Commissioning and Decommissioning

Learning Outcomes:

- Demonstrate knowledge of startup and shutdown procedures.
- Demonstrate knowledge of commissioning and decommissioning procedures.

IEL 2015 Red Seal Occupational Standard Reference:

5.01 Commissions systems.
5.02 Performs shutdown and startup procedures.
5.03 Decommissions systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with commissioning and decommissioning.

2. Identify hazards and describe safe work practices pertaining to starting up, shutting down, commissioning and decommissioning systems or equipment.
   i) hazards
      - arc flash/blast
      - moving and rotating equipment
      - electric shocks
        - stored potential energy
      - mobile equipment
      - relocating power feed
   ii) safe work practices
      - arc flash/blast analysis
      - lock-out and tag-out
      - verification of proper operation

3. Describe the purpose of starting up, shutting down, commissioning and decommissioning and the types of systems and equipment requiring it.

4. Identify and interpret information sources and documentation pertaining to the starting up, shutting down, commissioning and decommissioning of systems or equipment.
   i) OEM manuals
   ii) single line diagrams
   iii) schematics
   iv) panel schedules

v) CEC
vi) CSA standards
vii) manufacturers' specifications
viii) site policies and procedures

5. Describe startup and shutdown procedures and the types of systems and equipment requiring it.

6. Identify diagnostic and testing equipment and procedures for commissioning and decommissioning systems.
   i) multimeters
   ii) voltage testers
   iii) ammeters
   iv) oscilloscopes
   v) power quality analyzers
   vi) high-pot testers
   vii) thermographic imaging devices
   viii) phase/motor rotation meters
   ix) insulation resistance testers
   x) ground loop testers
   xi) acoustic level sensor
   xii) protective relay testers
   xiii) high-voltage equipment testers
   xiv) vibration analysis devices
   xv) very low frequency (VLF) testers
   xvi) partial discharge tester

Practical Objectives:

N/A

IEL-450 Fire Alarm Systems

Learning Outcomes:

- Demonstrate knowledge of fire alarm systems, their applications and operation.
- Demonstrate knowledge of procedures to install, upgrade and connect fire alarm systems.
- Demonstrate knowledge of procedures to maintain fire alarm systems.

IEL 2021 Red Seal Occupational Standard Reference:

26.01 Installs fire alarm systems.
26.02 Maintains fire alarm systems.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with fire alarm systems.

2. Identify hazards and describe safe work practices pertaining to fire alarm systems.

3. Interpret codes, regulations and standards pertaining to fire alarm systems.
   i) Canadian Electrical Code
   ii) Underwriters Laboratories of Canada
   iii) National Building Code
   iv) National Fire Code
   v) Regulations specific to AHJ

4. Interpret information pertaining to fire alarm systems found on drawings and specifications.

5. Identify types of fire alarm systems and describe their characteristics, applications and operation.
   i) non-addressable (Class A, Class B)
      - single stage/single zone
      - multi-zone
      - two-stage
   ii) addressable (Class A, Class B, DCLA, DCLB, DCLC)
      - single stage/single zone
      - multi-zone
      - two-stage

6. Identify fire alarm system components and describe their characteristics and applications.
   - i) end of line devices
     - resistors
     - diodes
   - ii) initiating devices
     - heat sensors
     - pull stations
     - fire/flame detectors
     - flow switches
     - gate valve switch
     - monitoring modules
     - smoke detectors
     - tamper switches
   - iii) signalling devices
     - horns
     - strobes
     - bells
   - iv) panels
     - fire alarm panels (stand-by batteries)
     - annunciator panels
   - v) relays

7. Describe types of associated systems that interconnect with fire alarm systems.
   - i) fire suppression systems
   - ii) emergency power supplies fan shutdown/startup
   - iii) PA systems
   - iv) local fire department
   - v) magnetic door holders
   - vi) elevator homing contactors
   - vii) egress door securing and releasing devices
   - viii) building automation systems
     - ancillary devices (suppression system contactors and fans)

8. Identify considerations and requirements for selecting fire alarm systems and their components.

9. Identify tools and equipment relating to fire alarm systems and describe their applications and procedures for use.

10. Describe the procedures used to install and connect fire alarm systems and their components.

11. Describe the procedures used to maintain fire alarm systems and their components.

12. Describe the procedures used to test fire alarm systems and their components.

13. Describe the procedures to commission and verify fire alarm systems.

Practical Objectives:

N/A

IEL-455 Security and Surveillance Systems

Learning Outcomes:

- Demonstrate knowledge of security and surveillance systems, their applications and operation.
- Demonstrate knowledge of procedures to install and connect security and surveillance systems.
- Demonstrate knowledge of procedures to maintain security and surveillance systems.

IEL 2021 Red Seal Occupational Standard Reference:

26.03 Installs security and surveillance systems.
26.04 Maintains security and surveillance systems.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with security and surveillance systems.

2. Identify hazards and describe safe work practices pertaining to security and surveillance systems.

3. Interpret codes, regulations and standards pertaining to security and systems.

4. Interpret information pertaining to security and surveillance systems found on drawings and specifications.

5. Identify types of security and surveillance systems and describe their characteristics, applications and operation.
   i) perimeter
   ii) space
   iii) spot

6. Identify security and surveillance system components and describe their characteristics and applications.
   i) devices
      - detection/monitoring
      - alarm/signaling
      - access
   ii) control panels

7. Describe types of associated systems that interconnect with security and surveillance systems.
   i) central alarm monitoring
   ii) automatic doors
   iii) LAN
   iv) building automation systems
   v) lighting

8. Identify tools and equipment relating to security and surveillance systems and describe their applications and procedures for use.

9. Identify considerations and requirements for selecting security and surveillance systems and their components.

10. Describe the procedures used to install and connect security and surveillance systems and their components.

11. Describe the procedures used to maintain security and surveillance systems and components.

12. Describe the procedures used to test security and surveillance systems and their components.

13. Describe the procedures used to commission and verify security and surveillance systems.

Practical Objectives:

N/A

IEL-460 Communication Systems (Voice/Data/Video and Closed-Circuit TV)

Learning Outcomes:

- Demonstrate knowledge of VDV and CCTV systems, their applications and operation.
- Demonstrate knowledge of procedures to install and connect VDV and CCTV systems
- Demonstrate knowledge of procedures to maintain VDV and CCTV systems.

IEL 2021 Red Seal Occupational Standard Reference:

27.01 Installs communication systems.
27.02 Maintains communication systems.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with VDV and CCTV systems.

2. Identify hazards and describe safe work practices pertaining to VDV and CCTV systems.

3. Interpret codes, regulations and standards pertaining to VDV and CCTV systems.

4. Interpret information pertaining to VDV and CCTV systems found on drawings and specifications.

5. Identify types of VDV and CCTV systems and describe their characteristics, applications and operation.

6. Identify VDV and CCTV system components and accessories and describe their characteristics and applications.

7. Identify methods of data transfer and describe their applications.
   i) structured cabling
   ii) fiber optic
   iii) wireless

8. Describe types of associated systems that interconnect with VDV and CCTV systems.

9. Identify tools and equipment relating to VDV and CCTV systems and describe their applications and procedures for use.

10. Identify considerations and requirements for selecting VDV and CCTV systems and their components.

11. Describe the procedures used to install and connect VDV and CCTV systems and their components.

12. Describe the procedures used to maintain VDV and CCTV systems and their components.

13. Describe the procedures used to test VDV and CCTV systems and their components.

Practical Objectives:

N/A

IEL-465 Communication Systems (Public Address and Intercom Systems)

Learning Outcomes:

- Demonstrate knowledge of public address (PA) and intercom systems, their applications and operation.
- Demonstrate knowledge of procedures to install and connect PA and intercom systems.
- Demonstrate knowledge of procedures to maintain PA and intercom systems.

IEL 2021 Red Seal Occupational Standard Reference:

27.01 Installs communication systems.
27.02 Maintains communication systems.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with PA and intercom systems.

2. Identify hazards and describe safe work practices pertaining to PA and intercom systems.

3. Interpret codes, regulations and standards pertaining to PA and intercom systems.

4. Interpret information pertaining to PA and intercom systems found on drawings and specifications.

5. Identify types of PA and intercom systems and describe their characteristics, applications and operation.

6. Identify PA and intercom system components and accessories and describe their characteristics and applications.

7. Identify methods of data transfer and describe their applications.
   i) structured cabling
   ii) fiber optic
   iii) wireless

8. Describe types of associated systems that interconnect with PA and intercom systems.

9. Identify tools and equipment relating to PA and intercom systems and describe their applications and procedures for use.

10. Identify considerations and requirements for selecting PA and intercom systems and their components.

11. Describe the procedures used to install and connect PA and intercom systems and their components.

12. Describe the procedures used to maintain PA and intercom systems and their components.

13. Describe the procedures used to test PA and intercom systems and their components.

Practical Objectives:

N/A

IEL-470 Communication Systems (Nurse Call Systems)

Learning Outcomes:

- Demonstrate knowledge of nurse call systems, their applications and operation.
- Demonstrate knowledge of procedure to install and connect nurse call systems.
- Demonstrate knowledge of procedures to maintain nurse call systems.

IEL 2021 Red Seal Occupational Standard Reference:

27.01 Installs communication systems.
27.02 Maintains communication systems.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with nurse call systems.

2. Identify hazards and describe safe work practices pertaining to nurse call systems.

3. Interpret codes, regulations and standards pertaining to nurse call systems.

4. Interpret information pertaining to nurse call systems found on drawings and specifications.

5. Identify types of nurse call systems and describe their characteristics, applications and operation.

6. Identify nurse call system components and accessories and describe their characteristics and applications.

7. Identify methods of data transfer and describe their applications.
   i) structured cabling
   ii) fiber optic
   iii) wireless

8. Describe types of associated systems that interconnect with nurse call systems.

9. Identify considerations and requirements for selecting nurse call systems and their components.

10. Describe the procedures used to install and connect nurse call systems and their components.

11. Describe the procedures used to maintain nurse call systems and their components.

12. Describe the procedures used to test nurse call systems and their components.

Practical Objectives:

N/A

IEL-475 Building Automation and Control Systems

Learning Outcomes:

- Demonstrate knowledge of building automation and control systems, their applications and operation.
- Demonstrate knowledge of procedures to install building automation and control systems
- Demonstrate knowledge of procedures to maintain building automation and control systems
- Demonstrate knowledge of emerging technologies and sustainable construction practices in smart buildings.

IEL 2021 Red Seal Occupational Standard Reference:

28.01 Installs building automation systems.
28.02 Maintains building automation systems.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with building automation and control systems.
   i) smart buildings
   ii) energy efficiency
   iii) smart grids

2. Identify hazards and describe safe work practices pertaining to building automation and control systems.

3. Interpret codes, regulations and standards pertaining to building automation and control systems.

4. Interpret information pertaining to building automation and control systems found on drawings and specifications.

5. Identify types of building automation and control systems and describe their characteristics, applications and operation
   i) energy management
   ii) security and surveillance

6. Identify building automation and control systems and describe their characteristics, applications, and operation.
    i) network cabling
    ii) sensors and devices (temperature, occupancy, light levels)
    iii) servers
    iv) power over ethernet (PoE) switches
    v) graphical user interfaces (GUIs)

7. Identify types of building control systems and describe their characteristics and applications.
    i) pneumatic
    ii) analog electrical
    III) direct digital
    iv) computer control

8. Identify building control systems components and describe their characteristics and applications.
    i) damper motors
    ii) valves
    iii) contactors
    iv) contacts
    v) annunciators
    vi) thermostats
    vii) solenoids
    viii) flow and sail switches
    ix) sensors

9. Describe types of associated systems that interconnect with building automation and control systems.
    i) local area network (LAN)
    ii) elevator systems
    iii) fire alarm and suppression systems
    iv) security and surveillance systems
    v) heating, ventilation and air conditioning (HVAC)
    vi) lighting
    vii) renewable energy systems

10. Identify tools and equipment used to install and maintain building automation and control systems and describe their applications and procedures for use.

11. Identify considerations and requirements for selecting building automation and control systems and their components.

12. Describe the procedures used to install building automation and control systems and their components.

13. Describe the procedures used to maintain building automation and control systems and their components.

13. Describe the procedures used to test building automation and control systems and their components.

14. Describe the procedures used to commission and verify building automation and control systems.

16. Describe emerging technologies and sustainable practices.
    i) monitoring and diagnostics
    ii) energy-efficient materials
    iii) innovations in smart buildings
        - (Internet of Things (IoT)
        - cloud-based systems

Practical Objectives:

N/A

IEL-480 Predictive/Preventative Maintenance

Learning Outcomes:

- Demonstrate knowledge of procedures to perform predictive/preventative maintenance.

IEL 2021 Red Seal Occupational Standard Reference:

Integrated throughout

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with predictive/preventative maintenance.

2. Identify hazards and describe safe work practices pertaining to predictive/preventative maintenance.

3. Identify tools and equipment used for predictive/preventative maintenance and describe their applications and procedures for use.

4. Identify and interpret sources of information pertaining to predictive/preventative maintenance.
   i) manufacturers' specifications
   ii) OEM manuals
   iii) standards and charts
   iv) data/historical records

5. Identify types of maintenance programs and describe their purpose.
   i) preventative
   ii) predictive
   iii) proactive

6. Identify methods of predictive maintenance and describe their associated procedures.
   i) non-destructive testing
      - megohm meter
      - thermal
      - ultra sonic
      - micrometer
   ii) vibration analysis

iii) oil analysis

7. Record and interpret data collected during predictive/preventative maintenance.

Practical Objectives:

N/A

IEL-485 Automated Control Systems

Learning Outcomes:

- Demonstrate knowledge of automated control systems, their components, applications and operation.
- Demonstrate knowledge of data communication systems for automated control systems.
- Demonstrate knowledge of procedures to install and connect automated control systems and their components.
- Demonstrate knowledge of procedures to maintain automated control systems.
- Demonstrate knowledge of procedures to program, configure and optimize automated control systems.

IEL 2021 Red Seal Occupational Standard Reference:

30.01 Installs automated control systems.
30.02 Maintains automated control systems.
30.03 Programs automated control systems.
30.04 Optimizes system performance.

Suggested Hours:

60 Hours

Theoretical Objectives:

1. Define terminology associated with automated control systems.

2. Interpret codes, regulations and standards pertaining to automated control systems.

3. Interpret information pertaining to automated control systems found on drawings and specifications.

4. Identify sources of information pertaining to automated control system service, maintenance, configuration and programming.

5. Identify number and code systems and describe their applications.
   i) number systems
      - binary
      - decimal
      - hexadecimal
      - octal
   ii) code systems

- binary coded decimal (BCD)
- American Standard Code for Information Interchange (ASCII)
- gray code

6. Explain and interpret control circuit logic.
   i) relay logic
   ii) ladder logic
   iii) function block
   iv) text based

7. Identify types of automated control systems and describe their characteristics.
   i) PLC
   ii) SCADA
   iii) DCS
   iv) DNP

8. Identify automated control system components and describe their purpose and operation.
   i) hardware
      - power supply
      - central processing unit (CPU)
      - input/output (I/O) system
      - programming terminals
   ii) software

9. Identify types of automated control system data communication systems and describe their characteristics.
   i) Ethernet
   ii) Modbus
   iii) Profibus
   iv) BACnet
   v) Fieldbus
   vi) DeviceNet

10. Identify automated control system data communication system components and describe their characteristics.

11. Identify devices used to communicate with interconnected automated control systems.
   i) handheld mobile devices
   ii) computer
   iii) human machine interface (HMI)

12. Identify basic instruction sets for ladder logic and describe their applications.
   i) examine-on (normally open contact)

ii) examine-off (normally closed contact)
iii) output energized (OTE)

13. Identify tools and equipment relating to automated control systems and describe their applications and procedures for use.

14. Describe the procedures used to install and connect automated control systems and their components.

15. Describe the procedures used to maintain automated control systems and their components.

16. Identify automated control system programming languages and describe their applications.
    i) ladder diagram (LD)
    ii) function block diagram (BD)
    iii) structured text (ST)
    iv) instruction list (IL)
    v) sequential function chart (SFC)

17. Describe the procedures used to program, edit and configure automated control systems.
    i) online
    ii) offline

18. Perform conversions between number systems.

Practical Objectives:

1. Design, program, and execute a program for a PLC.

IEL-490 Pneumatic Control Systems

Learning Outcomes:

- Demonstrate knowledge of pneumatic control systems, their components and operation.
- Demonstrate knowledge of pneumatic related calculations.
- Demonstrate knowledge of procedures to install pneumatic control system equipment and components.
- Demonstrate knowledge of procedures to maintain pneumatic control system equipment and components.

IEL 2021 Red Seal Occupational Standard Reference:

31.01 Installs pneumatic control systems.
31.02 Maintains pneumatic control systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with pneumatic control systems.

2. Identify hazards and describe safe work practices pertaining to pneumatic control systems.

3. Interpret codes, regulations and standards pertaining to pneumatic control systems.

4. Interpret information pertaining to pneumatic control systems devices found on drawings and specifications.

5. Interpret schematics to determine the operation of a pneumatic control system.

6. Identify types of pneumatic control systems and describe their applications and operation.
   i) instrument air
   ii) instrument gas

7. Identify types of pneumatic control system components and describe their purpose and operation.

8. Identify tools and equipment used to install and maintain pneumatic control systems and describe their applications and procedures for use.

9. Describe the procedures used to install pneumatic control systems and their components.

10. Describe the procedures used to maintain pneumatic control systems and their components.

11. Perform pneumatic related calculations.
    i) signal conversion
    ii) unit conversion

12. Describe the procedures to commission, startup, shutdown and decommission pneumatic control systems.

Practical Objectives:

N/A

IEL- 491 Hydraulic Systems and Control Devices

Learning Outcomes:

- Demonstrate knowledge of hydraulic systems and control devices, their applications and operation.
- Demonstrate knowledge of hydraulic control systems, their components and operation.
- Demonstrate knowledge of procedures to install hydraulic control system equipment and components.
- Demonstrate knowledge of procedures to maintain hydraulic control system equipment and components.

IEL 2021 Red Seal Occupational Standard Reference:

31.03 Installs hydraulic control systems.
31.04 Maintains hydraulic control systems.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with hydraulic systems and controls.

2. Identify hazards and describe safe work practices pertaining to hydraulic systems and controls.

3. Interpret codes, regulations and standards pertaining to hydraulic systems and controls.

4. Interpret information pertaining to hydraulic systems and controls found on drawings and specifications.

5. Identify schematics to determine the operation of hydraulic control systems.

6. Identify hydraulic control system components and describe their purpose and operation.
   i) pumps
   ii) motors
   iii) actuators
   iv) valves
   v) accumulators

7. Identify tools and equipment used to install and maintain hydraulic control systems and components and describe their applications and procedures for use.

8. Describe the procedures used to install hydraulic control systems and their components.

9. Describe the procedures used to maintain hydraulic control systems and their components.

10. Describe the procedures to commission, startup, shutdown and decommission hydraulic control systems.

Practical Objectives:

N/A

IEL-492 Discrete and Analog Devices

Learning Outcomes:

- Demonstrate knowledge of analog devices, their applications and operation.
- Demonstrate knowledge of procedures to install discrete and analogue devices.
- Demonstrate knowledge of procedures to maintain discrete and analog devices.

IEL 2021 Red Seal Occupational Standard Reference:

29.01 Installs discrete input/output (I/O) devices.
29.02 Maintains discrete input/output (I/O) devices.
29.03 Installs analog input/output (I/O) devices.
29.04 Maintains analog input/output (I/O) devices.

Suggested Hours:

30 Hours

Theoretical Objectives:

1. Define terminology associated with discrete and analog devices.

2. Identify hazards and describe safe work practices pertaining to discrete and analog devices.

3. Interpret codes, regulations and standards pertaining to discrete and analog control devices.

4. Interpret information pertaining to discrete and analog control devices found on drawings and specifications.

5. Explain the use of discrete versus analog devices.

6. Identify types of discrete control devices and describe their characteristics and applications.
   i) input
      - pressure
      - proximity
      - level
      - motion
      - flow
      - temperature

- vibration
- stop/start stations

ii) output
- solenoid valves
- relays
- indicator lights

7. Identify types of analog control devices and describe their characteristics and applications.

i) input
- pressure
- proximity
- level
- motion
- flow
- temperature and vibration transmitters
- proportional valves
- encoders
- tachometers

ii) output
- proportional valves
- linear actuators
- transducers

8. Explain the use of discrete and analog control devices for measurement.

i) pressure
ii) temperature
iii) flow
iv) level
v) mass
vi) density
viii) position

9. Identify discrete control device components and accessories and describe their characteristics and applications.

10. Identify types of signals used with discrete and analog devices and describe their characteristics, applications and operation.

i) resistance
ii) current
iii) voltage (sinking or sourcing)

11. Identify considerations and requirements for selecting discrete and analog control devices, their components and accessories.

12 Identify tools and equipment used to install and maintain discrete and analog control devices and describe their applications and procedures for use.

13. Describe the procedures used to install and connect discrete and analog control devices, their components and accessories.

14. Describe the procedures used to calibrate discrete and analog control devices.

15. Describe the procedures used to maintain discrete and analog control devices, their components and accessories.

16. Describe the procedures used to test discrete and analog control devices, their components and accessories.

Practical Objectives:

1. Install and calibrate an analog device.

IEL-493 Process Control

Learning Outcomes:

- Demonstrate knowledge of process control and its purpose.
- Demonstrate knowledge of process controllers, their components and operation.
- Demonstrate knowledge of procedures to install, calibrate, troubleshoot and test process controllers.
- Demonstrate knowledge of procedures to tune process controllers.

IEL 2021 Red Seal Occupational Standard Reference:

30.02 Maintains automated control systems.
30.04 Optimizes system performance.

Suggested Hours:

30 Hours

Theoretical Objectives:

1. Define terminology associated with process control.

2. Identify hazards and describe safe work practices pertaining to process control.

3. Identify tools and equipment relating to process controllers and describe their applications and procedures for use.

4. Interpret information pertaining to process control found on drawings and specifications.

5. Explain process control and its purpose.

6. Identify methods of process control and describe their applications.

7. Identify modes of process control and describe their characteristics, operation and combinations.
   i) on-off
   ii) proportional (P)
   iii) integral (I)
   iv) derivative (D)
   v) P, I, PI, PD, PID

8. Explain process dynamics and their impact on process control.

9. Identify considerations and requirements for selecting process controllers.

10. Describe the procedures used to install, connect, and set-up process controllers.

11. Describe the procedures used to tune process controllers.

12. Identify types of control loops and describe their operation.
    i) closed loop
    ii) open loop

13. Describe the procedures used to troubleshoot process controllers.

14. Describe the procedures to commission, startup, shutdown and decommission process controllers.

Practical Objectives:

1. Set up a control loop.

IEL-494 Other Fixed Equipment and Controls

Learning Outcomes:

- Demonstrate knowledge of other fixed equipment and controls, their applications, maintenance, and procedures for use.
- Demonstrate knowledge of limitations and ratings of other fixed equipment and controls.
- Demonstrate knowledge of procedures to install other fixed equipment and controls.
- Demonstrate knowledge of procedures to maintain other fixed equipment and controls.

IEL 2021 Red Seal Occupational Standard Reference:

24.01 Installs other fixed equipment and associated controls.
24.02 Maintains other fixed equipment and associated controls.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with other fixed equipment and controls.

2. Identify hazards and describe safe work practices pertaining to other fixed equipment and controls.

3. Identify types of other fixed equipment and controls
   i) welding equipment
   ii) electro-magnets
   iii) electrostatic precipitators
   iv) industrial equipment
   v) x-ray equipment
   vi) conveyors
   vii) charging equipment

4. Interpret information pertaining to connecting other fixed equipment and controls.

5. Describe the procedures used to identify and replace malfunctioning components of other fixed equipment and controls.

6. Describe the procedures used to operate other fixed equipment and controls.

7. Describe the procedures used to troubleshoot and maintain other fixed equipment and controls.

Practical Objectives:

N/A

IEL-495 Program Review

Learning Outcomes:

- Demonstrate knowledge of the Red Seal Occupational Standard and its relationship to the Red Seal Exam.
- Demonstrate knowledge of overall comprehension of the trade in preparation for the Red Seal Exam.

CEL 2021 Red Seal Occupational Standard Reference:

Entire Red Seal Occupational Standard (RSOS)

Suggested Hours:

30 Hours

Theoretical Objectives:

1. Define terminology associated with an RSOS.
   i) major work activity
   ii) levels
   iii) tasks
   iv) sub-tasks

2. Explain how an RSOS is developed and the link it has with the Red Seal exam.
   i) development
   ii) validation
   iii) level and task weighting
   iv) examination breakdown (pie-chart)

3. Identify Red Seal products and describe their use for preparing for the Red Seal exam.
   i) red seal website
   ii) examination preparation guide
   iii) sample question
   iv) examination breakdown
   v) self-assessment

4. Explain the relationship between the RSOS and the AACS.

5. Review Common Occupational Skills for the Industrial Electrician trade as identified in the RSOS.
   i) safety-related functions
   ii) tools and equipment

iii) organizes work
iv) fabricates and installs support components
v) commissions and decommission systems
vi) communication and mentoring techniques

6. Review Process to Install and Maintain Generating, Transmission, Distribution and Service Systems for the Industrial Electrician trade as identified in the RSOS.
   i) utility and non-utility supply services and metering equipment
   ii) protection devices
   iii) low-voltage distribution systems
   iv) power conditioning systems
   v) grounding, bonding and ground-fault protection and detection systems
   vi) power generating and conversion systems
   vii) renewable energy generating and energy storage systems
   viii) high-voltage systems
   ix) transformers

7. Review process to Install and Maintain Wiring Systems for the Industrial Electrician trade as identified in the RSOS.
   i) raceways, cables, conductors and enclosures
   ii) branch circuitry and devices
   iii) heating, ventilation and air-conditioning electrical components
   iv) electric heating system and controls
   v) exit and emergency lighting systems
   vi) cathodic protection systems

8. Review process to Install and Maintain Rotating and Other Fixed Equipment for the Industrial Electrician trade as identified in the RSOS.
   i) motor starters and control devices
   ii) drives
   iii) other fixed equipment and associated controls
   iv) motors
   v) communication systems
   vi) integrated control systems

9. Review process to Install and Maintain Signalling and Communication Systems for the Industrial Electrician trade as identified in the RSOS.
   i) signalling systems
   ii) communication systems
   iii) building automation systems

10. Review process to Install and Maintain Process Control Systems for the Industrial Electrician trade as identified in the RSOS.
   i) input/output devices

ii) automated control systems
iii) pneumatic and hydraulic control systems

11. Review Canadian Electrical Code.

Practical Objectives:

N/A

Feedback and Revisions

This AACS will be amended periodically; comments or suggestions for improvements should be directed to:

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Any comments or suggestions received will be reviewed and considered to determine the course of action required. If the changes are deemed to be minor, they will be held for implementation during the next review cycle. If immediate change is deemed appropriate and approved by the Atlantic Trade Advisory Committee, it will result in a revision to this version of the AACS and will be detailed in the following section.

Version Changes

Revision Date	Section	Description of Change
2024	All Sections	Updated to RSOS