



# CONSTRUCTION ELECTRICIAN

2017

Based on the Atlantic Apprenticeship Curriculum Standard  
(pg. 12 for Level Structure)



## Preface

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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 Construction Electrician program.

This document contains all the technical training elements required to complete the Construction Electrician apprenticeship program and has been developed based on the 2015 Red Seal Occupational Standard (RSOS) and 2010 Interprovincial Program Guide. The RSOS and IPG can be found on the Red Seal website ([www.red-seal.ca](http://www.red-seal.ca)).

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

Level	Implementation Effective
Level 1	2017-2018
Level 2	2018-2019
Level 3	2019-2020
Level 4	2020-2021

*\*\* 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 Construction Electrician trade 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. Programs which have been deemed acceptable by the provincial apprenticeship authority will be identified in transfer credit matrix developed through the Atlantic Apprenticeship Harmonization Project.

## Acknowledgements

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## Table of Contents

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Preface.....	2
Acknowledgements.....	3
User Guide .....	5
Glossary of Terms .....	7
Essential Skills Profiles.....	9
Profile Chart.....	10
Recommended Atlantic Level Structure.....	12
Nova Scotia Program Structure .....	15
2015 CEL RSOS to AACCS Unit Comparison .....	18
Program Content	
Level 1.....	24
Level 2.....	75
Level 3.....	116
Level 4 .....	146
Feedback and Revisions.....	197

## User Guide

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Atlantic Apprenticeship Curriculum Standards (AACS) are developed based on The Red Seal Occupational Standard (RSOS), the Interprovincial Program Guides (IPG) and extensive industry consultation. This document represents the minimum content to be delivered as part of the harmonized Atlantic program for the Construction Electrician trade.

The AACS is deliberately constructed for ease of use and flexibility of structure in order 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 at the level will be through a multiple-choice Level examination administered through the jurisdictional apprenticeship authority.

## **User Guide** *(continued)*

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The 2015 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 in order to provide an indication of the time it should take to cover the material in the unit and is intended 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 actual 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 in order 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 mandatory 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.

Detailed content for each objective has not been developed. Where detail is required for clarity, content has been provided.

## **Glossary of Terms**

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

<b>ADJUST</b>	To put in good working order; regulate; bring to a proper state or position.
<b>APPLICATION</b>	The use to which something is put and/or the circumstance in which an individual would use it.
<b>CHARACTERISTIC</b>	A feature that helps to identify, tell apart or describe recognizably; a distinguishing mark or trait.
<b>COMPONENT</b>	A part that can be separated from or attached to a system; a segment or unit.
<b>DEFINE</b>	To state the meaning of (a word, phrase, etc.).
<b>DESCRIBE</b>	To give a verbal account of; tell about in detail.
<b>DIAGNOSE</b>	To analyze or identify a problem or malfunction.
<b>EXPLAIN</b>	To make plain or clear; illustrate; rationalize.
<b>IDENTIFY</b>	To point out or name objectives or types.
<b>INTERPRET</b>	To translate information from observation, charts, tables, graphs and written material.
<b>MAINTAIN</b>	To keep in a condition of good repair or efficiency.
<b>METHOD</b>	A means or manner of doing something that has procedures attached to it.
<b>OPERATE</b>	How an object works; to control or direct the functioning of.
<b>PROCEDURE</b>	A prescribed series of steps taken to accomplish an end.

## **Glossary of Terms** *(continued)*

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<b>PURPOSE</b>	The reason for which something exists or is done, made or used.
<b>SERVICE</b>	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).
<b>TECHNIQUE</b>	Within a procedure, the manner in which technical skills are applied.
<b>TEST</b>	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 or not it is working correctly.
<b>TROUBLESHOOT</b>	To follow a systematic procedure to identify and locate a problem or malfunction and its cause.

## Essential Skills Profiles

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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.

Essential Skills Profiles describe how workers in various occupations use each of the key essential skills. They include:

- a brief description of the occupation;
- examples of tasks that illustrate how each essential skill is applied; and,
- complexity ratings that indicate the level of difficulty of the example tasks.

Essential Skills profiles can be found on the Employment and Social Development Canada (ESDC) website at [www.esdc.gc.ca/eng/jobs/les/profiles/index.shtml](http://www.esdc.gc.ca/eng/jobs/les/profiles/index.shtml)

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

## Profile Chart

PERFORMS COMMON OCCUPATIONAL SKILLS			
ELE-100 Safety	ELE-105 Tools and Equipment	ELE-110 Access Equipment	ELE-115 Hoisting, Lifting and Rigging
ELE-125 Trade Documentation	MENT-700 Mentoring I	MENT-701 Mentoring II	ELE-135 Drawings, Schematics and Specifications I
ELE-165 Introduction to the Canadian Electrical Code	ELE-120 Support Components	ELE-220 Job Planning	ELE-140 Worksite Preparation and Organization
CEL-460 Commissioning and Decommissioning Systems	ELE-310 Drawings, Schematics and Specifications II		
THEORY CORE			
ELE-145 DC Theory	ELE-150 DC Circuits	ELE-155 Single-Phase AC Theory	ELE-320 Three-Phase Theory
ELE-160 Single-Phase AC Circuits I	ELE-240 Single-Phase AC Circuits II	ELE-225 Voltage Drop and Power Loss	ELE-295 DC Motors I
INSTALLS, SERVICES AND MAINTAINS GENERATING, DISTRIBUTION AND SERVICE SYSTEMS			
ELE-170 Grounding and Bonding I	ELE-175 Single-Phase Services	ELE-330 Three-Phase Services	ELE-335 Three Phase Distribution Equipment
ELE-245 Protective Devices	ELE-235 DC Generating Systems	ELE-340 AC Generating Systems	ELE-180 Single Phase Power Distribution Equipment
ELE-250 Extra-Low Voltage Transformers	ELE-255 Low-Voltage Single-Phase Transformers	ELE-345 Low-Voltage Three-Phase Transformers	ELE-350 High Voltage Transformers
CEL-415 High Voltage Equipment	CEL-420 High Voltage Cables	ELE-260 Renewable Energy and Storage Systems I	CEL-425 Renewable Energy and Storage Systems II
ELE-155 Single Phase AC Theory	ELE-225 Voltage Drop and Power loss	ELE-325 Ground Fault Detection Systems I	CEL-405 Grounding and Bonding Systems II

CEL-410 Power Conditioning, Uninterruptible Power Supply (UPS) and Surge Suppression Systems			
<b>INSTALLS, SERVICES AND MAINTAINS WIRING SYSTEMS</b>			
ELE-185 Conductors and Cables	ELE-190 Conduit, Tubing and Fittings	ELE-195 Raceways	ELE-200 Boxes and Enclosures
ELE-205 Wiring Devices	ELE-210 Luminaires and Lighting Controls	ELE-315 Lightning Protection Systems	ELE-265 Exit and Emergency Lighting Systems
ELE-270 Heating, Ventilation and Air Conditioning Systems	ELE-275 Heating, Ventilation and Air-Conditioning System Controls	ELE-280 Electric Heating Systems	ELE-285 Electric Heating System Controls
ELE-290 Cathodic Protection Systems	ELE-230 Environmental and Hazardous Installations		
<b>INSTALLS, SERVICES AND MAINTAINS MOTORS AND CONTROL SYSTEMS.</b>			
ELE-300 Motor Starters I	ELE-305 Motor Control Devices I	ELE-360 Motor Control Devices II	ELE-365 Single-Phase Motors I
ELE-375 DC Motors II	ELE-370 Three-Phase Motors I	CEL-465 Automated Control Systems	ELE-380 AC Drives
ELE-385 DC Drives	ELE-355 Motor Starters II	ELE-295 DC Motors I	CEL-445 Single Phase Motors II
CEL-450 Three-Phase Motors II	CEL-455 DC Motors III		
<b>INSTALLS, SERVICES AND MAINTAINS SIGNALLING AND COMMUNICATION SYSTEMS</b>			
CEL-470 Fire Alarm Systems	CEL-475 Security and Surveillance Systems	CEL-480 Communication Systems (VDV and CATV)	CEL-485 Communication Systems (PA and Intercom Systems)
CEL-490 Communication Systems (Nurse Call Systems)	ELE-215 Introduction to Communication Systems	CEL-495 Building Automation and Control Systems	CEL-435 Airport Runway Lighting Systems and Controls
CEL-430 Lighting Standards	CEL-440 Traffic Signal Lights and Controls		

## Recommended Atlantic Level Structure

### Level 1 - 10 Weeks

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
ELE-100	Safety	6	25	N/A
ELE-105	Tools and Equipment	6	28	N/A
ELE-110	Access Equipment	6	30	N/A
ELE-115	Hoisting, Lifting and Rigging	6	32	Demonstrate the ability to tie common rigging knots.
ELE-120	Support Components	6	34	N/A
ELE-125	Trade Documentation	6	36	N/A
MENT-700	Mentoring I	6	38	N/A
ELE-135	Drawings, Schematics and Specifications I	12	40	N/A
ELE-140	Worksite Preparation and Organization	6	42	N/A
ELE-145	DC Theory	30	44	Use instruments to troubleshoot DC components (closed circuit, open circuit, short circuit).
ELE-150	DC Circuits	30	46	Use instruments to troubleshoot series, parallel and complex DC circuits.
ELE-155	Single-Phase AC Theory	18	48	N/A
ELE-160	Single-Phase AC Circuits I	30	50	Use electrical instruments to troubleshoot series and parallel AC circuits.
ELE-165	Introduction to the Canadian Electrical Code	6	52	Locate and interpret information in the CEC.
ELE-170	Grounding and Bonding I	6	54	N/A
ELE-175	Single Phase Services	18	56	Install a single-phase service.
ELE-180	Single Phase Power Distribution Equipment	18	58	N/A
ELE-185	Conductors and Cables	18	60	Install, splice and terminate conductors and cables.
ELE-190	Conduit, Tubing and Fittings	12	62	Cut and bend conduit and tubing.
ELE-195	Raceways	6	64	N/A
ELE-200	Boxes and Enclosures	12	66	N/A
ELE-205	Wiring Devices	6	68	N/A
ELE-210	Luminaires and Lighting Controls	24	70	Install a luminaire and lighting controls with operation from multiple locations.
ELE-215	Introduction to Communication Systems	6	73	N/A

**Level 2 - 9 Weeks**

<b>Unit Code</b>	<b>Unit Title</b>	<b>Sugg Hrs*</b>	<b>Pg #</b>	<b>Practical Objectives*</b>
ELE-220	Job Planning	6	77	N/A
ELE-225	Voltage Drop and Power Loss	30	78	N/A
ELE-230	Environmental & Hazardous Installations	24	80	N/A
ELE-235	DC Generating Systems	12	82	N/A
ELE-240	Single-Phase AC Circuits II	27	84	N/A
ELE-245	Protection Devices	24	86	N/A
ELE-250	Extra-Low Voltage Transformers	6	89	N/A
ELE-255	Low-Voltage Single-Phase Transformers	12	91	N/A
ELE-260	Renewable Energy and Storage Systems I	9	93	N/A
ELE-265	Exit and Emergency Lighting Systems	12	95	N/A
ELE-270	Heating, Ventilation & A/C Systems	18	97	N/A
ELE-275	Heating, Ventilation & A/C Sys Controls	12	99	N/A
ELE-280	Electric Heating Systems	12	101	N/A
ELE-285	Electric Heating System Controls	12	103	N/A
ELE-290	Cathodic Protection Systems	6	105	N/A
ELE-295	DC Motors I	12	107	N/A
ELE-300	Motor Starters I	6	109	N/A
ELE-305	Motor Control Devices I	12	111	N/A
ELE-310	Drawings, Schematics & Specifications II	12	113	N/A
ELE-315	Lightning Protection Systems	6	115	N/A

**Level 3 - 8 Weeks**

<b>Unit Code</b>	<b>Unit Title</b>	<b>Sugg Hrs*</b>	<b>Pg #</b>	<b>Practical Objectives*</b>
ELE-320	Three-Phase Theory	30	118	N/A
ELE-325	Ground Fault Detection Systems I	12	120	N/A
ELE-330	Three-Phase Services	12	122	N/A
ELE-335	Three-Phase Power Distribution Equipment	18	124	N/A
ELE-340	AC Generating Systems	18	127	N/A
ELE-345	Low-Voltage Three-Phase Transformers	18	129	Install, connect and test a low-voltage three-phase transformer.
ELE-350	High Voltage Transformers	12	131	N/A
ELE-355	Motor Starters II	18	133	N/A
ELE-360	Motor Control Devices II	24	135	Connect and operate control circuits.
ELE-365	Single-Phase Motors I	18	137	Connect and operate single-phase motors.
ELE-370	Three-Phase Motors I	18	139	Connect and operate three-phase motors.
ELE-375	DC Motors II	12	141	Connect and operate DC motors.
ELE-380	AC Drives	18	143	Connect, configure and operate AC drives.
ELE-385	DC Drives	12	145	N/A

**Level 4 - 7 Weeks**

<b>Unit Code</b>	<b>Unit Title</b>	<b>Sugg Hrs*</b>	<b>Pg #</b>	<b>Practical Objectives*</b>
MENT-701	Mentoring II	6	147	N/A
CEL-405	Grounding and Bonding Systems II	6	149	N/A
CEL-410	Power Conditioning, Uninterruptible Power Supply (UPS) and Surge Suppression Systems	12	150	N/A
CEL-415	High Voltage Equipment	12	152	N/A
CEL-420	High Voltage Cables	12	155	N/A
CEL-425	Renewable Energy and Storage Systems II	12	157	N/A
CEL-430	Lighting Standards	6	159	N/A
CEL-435	Airport Runway Lighting Systems and Controls	6	161	N/A
CEL-440	Traffic Signal Lights and Controls	6	163	N/A
CEL-445	Single-Phase Motors II	6	165	N/A
CEL-450	Three-Phase Motors II	6	166	N/A
CEL-455	DC Motors III	6	167	N/A
CEL-460	Commissioning and Decommissioning Systems	12	168	N/A
CEL-465	Automated Control Systems	30	170	N/A
CEL-470	Fire Alarm Systems	12	173	N/A
CEL-475	Security and Surveillance Systems	6	176	N/A
CEL-480	Communication Systems (Voice/Data/Video and Community Antenna Television)	6	177	N/A
CEL-485	Communication Systems (Public Address and Intercom Systems)	3	181	N/A
CEL-490	Communication Systems (Nurse Call Systems)	3	184	N/A
CEL-495	Building Automation and Control Systems	12	186	N/A
CEL-496	Electric Vehicle Charging Stations	6	194	N/A
CEL-500	Program Review	30	196	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.

## Nova Scotia Online Courses

Nova Scotia Course #	Nova Scotia Course Name	Nova Scotia Prerequisites	AACCS Units		Sug hrs
<b>Level 1 (10 weeks)</b>					
MENT-700	Mentoring I	None	MENT-700	Mentoring I	6
ELEA-0801	Safety Practices / Electrical Code	None	ELE-100	Safety	6
			ELE-165	Introduction to the Canadian Electrical Code	6
ELEA-0802	Drawings and Documentation	None	ELE-125	Trade Documentation	6
			ELE-135	Drawings, Schematics and Specifications I	12
			ELE-140	Worksite Preparation & Organization	6
ELEA-1804	Tools & Equipment	ELEA-0801	ELE-105	Tools and Equipment	6
			ELE-110	Access Equipment	6
			ELE-115	Hoisting, Lifting and Rigging	6
			ELE-120	Support Components	6
ELEA-1842	DC Theory	None	ELE-145	DC Theory	30
ELEA-1843	DC Circuits	ELEA-1842	ELE-150	DC Circuits	30
ELEA-1844	Raceways, Conductors, Enclosures and Devices	ELEA-1842 ELEA-1843	ELE-185	Conductors and Cables	18
			ELE-195	Raceways	6
			ELE-190	Conduit, Tubing and Fittings	12
			ELE-200	Boxes and Enclosures	12
			ELE-205	Wiring Devices	6
ELEA-1845	Single-Phase AC Theory	ELEA-1842	ELE-155	Single Phase AC Theory	18
ELEA-1846	Single-Phase AC Circuits I	ELEA-1845	ELE-160	Single Phase AC Circuits I	30
ELEA-1832	Single-Phase Service Entrance	ELEA-1844 ELEA-1846	ELE-170	Grounding and Bonding I	6
			ELE-175	Single Phase Services	18
			ELE-180	Single Phase Power Distribution Equipment	18
ELEA-1847	Luminaires and Introduction to Communication Systems	ELEA-1845	ELE-210	Luminaires and Lighting Controls	24
			ELE-215	Introduction to Communication Systems	6
<b>Level 2 (9 weeks)</b>					
ELEA-1848	Job Planning, Drawings II and Lightning Protection Systems	ELEA-0802 ELEA-1832	ELE-220	Job Planning	6
			ELE-310	Drawing, Schematics and Specifications II	12
			ELE-315	Lightning Protection Systems	6
ELEA-1849	Single-Phase AC Circuits II	ELEA-1845 ELEA-1846	ELE-240	Single Phase AC Circuits II	27
ELEA-1850	Voltage Drop and Power Loss	ELEA-1844	ELE-225	Voltage Drop and Power Loss	30

<b>Nova Scotia Course #</b>	<b>Nova Scotia Course Name</b>	<b>Nova Scotia Prerequisites</b>	<b>AACS Units</b>		<b>Sug hrs</b>
ELEA-1851	DC Generating Systems and DC Motors I	ELEA-1842	ELE-235	DC Generating Systems	12
			ELE-295	DC Motors I	12
ELEA-1852	Protective Devices and Cathodic Protection Systems	ELEA-1845 ELEA-1849	ELE-245	Protective Devices	24
			ELE-290	Cathodic Protection Systems	6
ELEA-1853	Single Phase Transformers	None	ELE-250	Extra-Low Voltage Transformers	6
			ELE-255	Low-Voltage Single Phase Transformers	12
			ELE-265	Exit and Emergency Lighting Systems	12
ELEA-1854	Environmental and Hazardous Installations / Renewable Energy and Storage Systems I	ELEA-1844	ELE-230	Environmental and Hazardous Installations	24
			ELE-260	Renewable Energy and Storage Systems I	9
ELEA-1855	Heating, Ventilation and Air Conditioning	ELEA-1849	ELE-270	Heating, Ventilation and Air-Conditioning Systems	18
			ELE-275	Heating, Ventilation and Air-Conditioning System Controls	12
			ELE-280	Electric Heating Systems	12
			ELE-285	Electric Heating System Controls	12
ELEA-1856	Motor Starters I and Control Devices I	ELEA-1849 ELEA-1853	ELE-300	Motor Starters I	6
			ELE-305	Motor Control Devices I	12
<b>Level 3 (8 weeks)</b>					
ELEA-1857	Three Phase Theory	ELEA-1845	ELE-320	Three Phase Theory	30
ELEA-1858	Three-Phase Transformers	ELEA-1853 ELEA-1857	ELE-345	Low-Voltage Three Phase Transformers	18
			ELE-350	High Voltage Transformers	12
ELEA-1816	AC Generators / Three-Phase Motors	ELEA-1857	ELE-340	AC Generating Systems	18
			ELE-370	Three-Phase Motors I	18
ELEA-1815	Single-Phase Motors	ELEA-1849	ELE-365	Single-Phase Motors I	18
ELEA-1859	Motor Starters II and Control Devices II	ELEA-1856	ELE-355	Motor Starters II	18
			ELE-360	Motor Control Devices II	24
ELEA-1860	Three-Phase Service and Distribution Equipment	ELEA-1832	ELE-330	Three-Phase Services	12
			ELE-335	Three-Phase Power Distribution Equipment	18
ELEA-1861	Drives	ELEA-1849	ELE-380	AC Drives	18
			ELE-385	DC Drives	12
ELEA-1862	Ground Fault Detection Systems I and DC Motors II	ELEA-1851	ELE-325	Ground Fault Detection Systems I	12
			ELE-375	DC Motors II	18

Nova Scotia Course #	Nova Scotia Course Name	Nova Scotia Prerequisites	AACCS Units		Sug hrs
<b>Level 4 – (7 weeks)</b>					
MENT-701	Mentoring II	MENT-1801	MENT-701	Mentoring II	6
ELEA-1813	High-Voltage Systems	ELEA-1844	CEL-415	High Voltage Equipment	12
			CEL-420	High Voltage Cables	12
ELEA-1821	Fire Alarm and Security Systems	ELEA-1849	CEL-470	Fire Alarm Systems	12
			CEL-475	Security and Surveillance Systems	6
ELEA-1863	Control Systems	ELEA-1849	CEL-465	Automated Control Systems	30
			CEL-495	Building Automation and Control Systems	12
ELEA-1864	Motor Maintenance and Service / Runway Lighting and Traffic Signals	ELEA-1847 ELEA-1851 ELEA-1815 ELEA-1816 ELEA-1862	CEL-445	Single Phase Motors II	6
			CEL-450	Three-Phase Motors II	6
			CEL-455	DC Motors III	6
			CEL-430	Lighting Standards	6
			CEL-435	Airport Runway Lighting Systems and Controls	6
			CEL-440	Traffic Signal Lights and Controls	6
ELEA-1865	Commissioning and Decommissioning / Communication Systems	ELEA-1844	CEL-460	Commissioning and Decommissioning Systems	12
			CEL-480	Communication Systems (Voice/Data/Video and Community Antenna Television)	6
			CEL-485	Communication Systems (Public Address and Intercom Systems)	3
			CEL-490	Communication Systems (Nurse Call Systems)	3
ELEA-1866	Grounding and Bonding II / Conditioning and UPS	ELEA-1832 ELEA-1849	CEL-405	Grounding and Bonding Systems II	6
			CEL-410	Power Conditioning, Uninterruptible Power Supply (UPS) and Surge Suppression Systems	15
			CEL-425	Renewable Energy and Storage Systems II	12
ELEA-1835	Program Review	Entire Program	CEL-500	Program Review (NS Specific)	30
<b>Nova Scotia Construction Electrician Apprenticeship Program: All Courses are Required</b>					

## 2015 RSOS Construction Electrician Sub-task to AACS Unit Comparison

2015 RSOS Construction		AACS Unit	
<b>Task 1 - Performs safety-related functions.</b>			
1.01	Uses personal protective equipment (PPE) and safety equipment	ELE-100	Safety
1.02	Maintains safe work environment.	ELE-100	Safety
1.03	Performs lock-out and tag-out procedures	ELE-100	Safety
<b>Task 2 - Uses tools and equipment</b>			
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
<b>Task 3 - Organizes work.</b>			
3.01	Interprets plans, drawings and specifications.	ELE-135	Drawings, Schematics and Specifications I
		ELE-310	Drawings, Schematics and Specifications II
3.02	Organizes materials and supplies	ELE-140	Worksite Preparation and Organization
3.03	Plans project tasks and procedures.	ELE-220	Job Planning
3.04	Prepares worksite.	ELE-140	Worksite Preparation and Organization
3.05	Finalizes required documentation.	ELE-125	Trade Documentation
<b>Task 4 - Fabricates and installs support components</b>			
4.01	Fabricates support structures.	ELE-120	Support Components
4.02	Installs brackets, hangers and fasteners.	ELE-120	Support Components
4.03	Installs seismic restraint systems.	ELE-120	Support Components
<b>Task 5 - Commissions and decommissions electrical systems</b>			
5.01	Performs startup and shutdown procedures.	ELE-175	Single-Phase Services
5.02	Performs commissioning and decommissioning of systems	ELE-175	Single-Phase Services
<b>Task 6 - Uses communication and mentoring techniques.</b>			
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
<b>Task 7 - Installs, services and maintains consumer/supply services and metering equipment.</b>			

2015 RSOS Construction		AACS Unit	
7.01	Installs single-phase consumer/supply services and metering equipment.	ELE-175	Single-Phase Services
7.02	Installs three-phase consumer/supply services and metering equipment	ELE-330	Three-Phase Services
7.03	Performs servicing and maintenance of single-phase services and metering equipment	ELE-175	Single-Phase Services
7.04	Performs servicing and maintenance of three-phase services and metering equipment	ELE-330	Three-Phase Services
<b>Task 8 - Installs, services and maintains protection devices.</b>			
8.01	Installs overcurrent protection devices..	ELE-245	Protective Devices
8.02	Installs ground fault, arc fault and surge protection devices.	ELE-245	Protective Devices
8.03	Performs servicing and maintenance of protection devices	ELE-245	Protective Devices
<b>Task 9 - Installs, services and maintains distribution equipment.</b>			
9.01	Installs power distribution equipment..	ELE-180	Single Phase Power Distribution Equipment
		ELE-335	Three Phase Power Distribution Equipment
9.02	Performs servicing and maintenance of power distribution equipment.	ELE-180	Single Phase Power Distribution Equipment
		ELE-335	Three Phase Power Distribution Equipment
<b>Task 10 - Installs, services and maintains power conditioning, uninterruptible power supply (UPS) and surge suppression systems.</b>			
10.01	Installs power conditioning, UPS and surge suppression systems	CEL-410	Power Conditioning, Uninterruptible Power Supply (UPS) and Surge Suppression Systems
10.02	Performs servicing and maintenance of power conditioning, UPS and surge suppression systems	CEL-410	Power Conditioning, Uninterruptible Power Supply (UPS) and Surge Suppression Systems
<b>Task 11 - Installs, services and maintains bonding and grounding protection systems.</b>			
11.01	Installs grounding and bonding systems.	ELE-170	Grounding and Bonding I
11.02	Installs ground fault systems.	ELE-325	Ground Fault Detection Systems I
11.03	Installs lightning protection systems.	ELE-315	Lightning Protection Systems
11.04	Performs servicing and maintenance of bonding and grounding systems.	CEL-405	Grounding and Bonding Systems II
<b>Task 12 - Installs, services and maintains power generation systems</b>			
12.01	Installs AC (alternating current) generating systems.	ELE-340	AC Generating Systems

2015 RSOS Construction		AACS Unit	
12.02	Performs servicing and maintenance of AC generating systems.	ELE-340	AC Generating Systems
12.03	Installs DC (direct current) generating systems. (NOT COMMON CORE)	ELE-235	DC Generating Systems
12.04	Performs servicing and maintenance of DC generating systems (NOT COMMON CORE)	ELE-235	DC Generating Systems
<b>Task 13 - Installs, services and maintains renewable energy systems.</b>			
13.01	Installs renewable energy systems	ELE-260	Renewable Energy and Storage Systems I
		CEL-425	Renewable Energy and Storage Systems II
13.02	Performs servicing and maintenance of renewable energy systems	CEL-425	Renewable Energy and Storage Systems II
<b>Task 14 - Installs, services and maintains high voltage systems.</b>			
14.01	Installs high voltage equipment	CEL-415	High Voltage Equipment
14.02	Installs high voltage cables	CEL-420	High Voltage Cables
14.03	Performs servicing and maintenance of high voltage systems	CEL-415	High Voltage Equipment
		CEL-420	High Voltage Cables
<b>Task 15 - Installs, services and maintains transformers.</b>			
15.01	Installs extra-low voltage transformers	ELE-250	Extra-Low Voltage Transformers
15.02	Installs low-voltage single-phase transformers.	ELE-255	Low-Voltage Single-Phase Transformers
15.03	Installs low-voltage three-phase transformers.	ELE-345	Low-Voltage Three-Phase Transformers
15.04	Installs high voltage transformers	ELE-350	High Voltage Transformers
15.05	Performs servicing and maintenance of transformers	ELE-250	Extra-Low Voltage Transformers
		ELE-345	Low-Voltage Three-Phase Transformers
		ELE-255	Low-Voltage Single-Phase Transformers
<b>Task 16 - Installs, services and maintains raceways, cables and enclosures.</b>			
16.01	Installs conductors and cables.	ELE-185	Conductors and Cables
16.02	Installs conduit, tubing and fittings.	ELE-190	Conduit, Tubing and Fittings
16.03	Installs raceways	ELE-195	Raceways
16.04	Installs boxes and enclosures	ELE-200	Boxes and Enclosures
16.05	Performs servicing and maintenance of raceways, cables and enclosures.	ELE-185	Conductors and Cables
		ELE-200	Boxes and Enclosures
<b>Task 17 - Installs, services and maintains branch circuitry</b>			
17.01	Installs luminaires	ELE-210	Luminaires and Lighting Controls
17.02	Installs wiring devices.	ELE-205	Wiring Devices
17.03	Installs lighting controls	ELE-210	Luminaires and Lighting Controls

2015 RSOS Construction		AACs Unit	
17.04	Installs lighting standards	ELE-205	Wiring Devices
17.05	Performs servicing of branch circuitry	ELE-205	Wiring Devices
		ELE-210	Luminaires and Lighting Controls
		CEL-435	Airport Runway Lighting Systems and Controls
17.06	Installs, services and maintains airport runway lighting systems	CEL-435	Airport Runway Lighting Systems and Controls
17.07	Installs, services and maintains traffic signal lights and controls.	CEL-440	Traffic Signal Lights and Controls
<b>Task 18 - Installs, services and maintains heating, ventilating and air-conditioning (HVAC) systems.</b>			
18.01	Connects HVAC systems..	ELE-270	Heating, Ventilation and Air-Conditioning Systems
18.02	Installs HVAC controls.	ELE-275	Heating, Ventilation and Air-Conditioning System Controls
18.03	Performs servicing and maintenance of HVAC systems and controls.	ELE-270	Heating, Ventilation and Air-Conditioning Systems
		ELE-275	Heating, Ventilation and Air-Conditioning System Controls
<b>Task 19 - Installs, services and maintains electric heating systems.</b>			
19.01	Installs electric heating systems	ELE-280	Electric Heating Systems
19.02	Installs electric heating system controls	ELE-285	Electric Heating System Controls
19.03	Performs servicing and maintenance of electric heating systems and controls	ELE-280	Electric Heating Systems
		ELE-285	Electric Heating System Controls
<b>Task 20 - Installs, services and maintains exit and emergency lighting systems.</b>			
20.01	Installs exit and emergency lighting.	ELE-265	Exit and Emergency Lighting Systems
20.02	Performs servicing and maintenance of exit and emergency lighting systems	ELE-265	Exit and Emergency Lighting Systems
<b>Task 21 - Installs, services and maintains cathodic protection systems.</b>			
21.01	Installs cathodic protection systems	ELE-290	Cathodic Protection Systems
21.02	Performs servicing and maintenance of cathodic protection systems	ELE-290	Cathodic Protection Systems
<b>Task 22 - Installs, services and maintains motor starters and controls</b>			
22.01	Installs motor starters.	ELE-300	Motor Starters I
22.02	Performs servicing and maintenance of motor starters.	ELE-300	Motor Starters I
22.03	Installs motor controls.	ELE-355	Motors Starters II
22.04	Performs servicing and maintenance of motor controls.	ELE-355	Motors Starters II
<b>Task 23 - Installs, services and maintains drives.</b>			
23.01	Installs AC drives	ELE-380	AC Drives

2015 RSOS Construction		AACS Unit	
23.02	Performs servicing and maintenance of AC drives	ELE-380	AC Drives
23.03	Installs DC drives	ELE-385	DC Drives
23.04	Performs servicing and maintenance of DC drives.	ELE-385	DC Drives
<b>Task 24 - Installs, services and maintains motors.</b>			
24.01	Installs single-phase motors.	ELE-365	Single-Phase Motors I
24.02	Performs servicing and maintenance of single- phase motors	CEL-445	Single-Phase Motors II
24.03	Installs three-phase motors.	ELE-370	Three-Phase Motors I
		CEL-450	Three-Phase Motors II
24.04	Servicing and maintenance of three-phase motors.	ELE-375	DC Motors II
24.05	Installs DC motors	ELE-295	DC Motors I
24.06	Performs servicing and maintenance of DC motors.	ELE-295	DC Motors I
<b>Task 25 - Installs, programs, services and maintains automated control systems.</b>			
25.01	Installs automated control systems	ELE-365	Single-Phase Motors I
		CEL-465	Automated Control Systems
25.02	Performs servicing and maintenance of automated control systems	CEL-465	Automated Control Systems
25.03	Programs and configures automated control systems.	CEL-465	Automated Control Systems
<b>Task 26 - Installs, services and maintains signaling systems.</b>			
26.01	Installs fire alarm systems..	CEL-470	Fire Alarm Systems
26.02	Performs servicing and maintenance of fire alarm systems.	CEL-470	Fire Alarm Systems
26.03	Installs security and surveillance systems.	CEL-475	Security and Surveillance Systems
26.04	Performs servicing and maintenance of security and surveillance systems.	CEL-475	Security and Surveillance Systems
<b>Task 27 – Installs, services and maintains communication systems.</b>			
27.01	Installs voice/data/video (VDV) and community antenna television (CATV) systems.	ELE-215	Introduction to Communication Systems
		CEL-480	Communication Systems (Voice/Data/Video and Community Antenna Television)
27.02	Installs public address (PA) and intercom systems.	ELE-215	Introduction to Communication Systems
		CEL-485	Communication Systems (Public Address and Intercom Systems)

2015 RSOS Construction		AACCS Unit	
		CEL-490	Communication Systems (Nurse Call Systems)
27.03	Installs nurse call systems.	ELE-215	Introduction to Communication Systems
		CEL-490	Communication Systems (Nurse Call Systems)
27.04	Performs servicing and maintenance of communication systems.	CEL-480	Communication Systems (Voice/Data/Video and Community Antenna Television)
		CEL-490	Communication Systems (Nurse Call Systems)
<b>Task 28 Installs, services and maintains integrated control systems.</b>			
28.01	Installs building automation systems.	CEL-495	Building Automation and Control Systems
28.02	Installs building control systems	CEL-495	Building Automation and Control Systems
28.03	Performs servicing and maintenance of integrated control systems	CEL-495	Building Automation and Control Systems

# Level 1

Unit Code	Unit Title	Suggested Hours	Page Number
ELE-100	Safety	6	23
ELE-105	Tools and Equipment	6	26
ELE-110	Access Equipment	6	28
ELE-115	Hoisting, Lifting and Rigging	6	30
ELE-120	Support Components	6	32
ELE-125	Trade Documentation	6	34
MENT-700	Mentoring I	6	36
ELE-135	Drawings, Schematics and Specifications I	12	38
ELE-140	Worksite Preparation and Organization	6	40
ELE-145	DC Theory	30	42
ELE-150	DC Circuits	30	44
ELE-155	Single-Phase AC Theory	18	46
ELE-160	Single-Phase AC Circuits I	30	48
ELE-165	Introduction to the Canadian Electrical Code	6	50
ELE-170	Grounding and Bonding I	6	51
ELE-175	Single Phase Services	18	53
ELE-180	Single Phase Power Distribution Equipment	18	55
ELE-185	Conductors and Cables	18	57
ELE-190	Conduit, Tubing and Fittings	12	60
ELE-195	Raceways	6	62
ELE-200	Boxes and Enclosures	12	64
ELE-205	Wiring Devices	6	66
ELE-210	Luminaires and Lighting Controls	24	68
ELE-215	Introduction to Communication Systems	6	71

## ELE-100            Safety

### Learning Outcomes:

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

### CEL 2015 Red Seal Occupational Standard Reference:

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

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify types of personal protective equipment (PPE) and safety equipment.
  - i) PPE
    - shock hazard PPE
    - arc flash hazard PPE
    - hard hats
    - safety glasses
    - safety footwear
    - gloves
    - hearing protection
  - ii) safety equipment
    - fall protection (fall arrest and fall restraint)

- confined space equipment
  - respiratory protection
  - lock-out and tag-out
  - fire extinguishers
  - first aid equipment
  - eye wash stations
  - signage
  - fume and toxic gas detectors
2. Describe applications and limitations of PPE and safety equipment.
  3. Describe the procedures used to care for, maintain and store PPE and safety equipment.
  4. Identify hazards and describe safe work practices to maintain safe work environment.
    - i) arc flashes
    - ii) liquid spills (flammable, corrosive, toxic)
    - iii) electric shocks
    - iv) designated substances (asbestos, mercury, lead, silica)
    - v) open holes
    - vi) confined space
    - vii) fire
    - viii) tripping hazards
    - ix) overhead work
    - x) hazardous locations
  5. Identify and interpret regulatory requirements and responsibilities pertaining to workplace safety and health regulations.
    - i) federal
      - Material Safety data Sheets (MSDS)/Globally Harmonized System of Classification and Labelling of Chemicals (GHS)
      - Workplace Hazardous Material Information System (WHMIS)
    - ii) provincial/territorial
    - iii) municipal
    - iv) site specific
  6. Describe the procedures used in emergency situations.
    - i) evacuation
    - ii) fire

- iii) hazardous chemical alarms
- 7. Identify and interpret the regulatory requirements pertaining to hazards and emergency situations.
- 8. Describe lock-out and tag-out procedures and legislation.
- 9. Describe safety checks to be performed to ensure zero energy state.
- 10. Describe the procedures used to determine that the testing equipment to be used is matched to the voltage and energy rating of the equipment being locked-out.

Practical Objectives

N/A

## **ELE-105                    Tools and Equipment**

### **Learning Outcomes:**

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

### **CEL 2015 Red Seal Occupational Standard Reference:**

2.01                    Uses common and specialty tools and equipment.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. 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
2. Describe operating and maintenance procedures of tools and equipment.
3. Describe the procedures used to inspect tools and equipment.
4. Describe limitations of electrical measuring equipment.

5. Identify the considerations for selecting electrical measuring equipment.
6. Describe certification requirements to use powder-actuated tools.

Practical Objectives

N/A

## **ELE-110            Access Equipment**

### **Learning Outcomes:**

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

### **CEL 2015 Red Seal Occupational Standard Reference:**

2.02            Uses access equipment.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Identify hazards and describe safe work practices pertaining to access equipment and the use of fall protection (fall arrest and fall restraint).
2. Identify and interpret the regulatory requirements and responsibilities pertaining to access equipment.
  - i) inspection documentation
  - ii) training and certification
3. Identify types of access equipment and describe their characteristics and applications.
  - i) ladders
  - ii) scissor-lifts
  - iii) scaffolding
  - iv) articulating booms
4. Describe the procedures used to erect and dismantle ladders and scaffolding respecting the authority having jurisdiction (AHJ).

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.

### **CEL 2015 Red Seal Occupational Standard Reference:**

2.03                    Uses rigging, hoisting and lifting equipment.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. 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) trenches
2. Identify and interpret codes and regulations pertaining to hoisting, lifting and rigging.
  - i) inspection documentation
  - ii) training and certification requirements
3. Identify types of rigging equipment and accessories and describe their applications and procedures for use.

4. Identify types of hoisting and lifting equipment and accessories and describe their applications and procedures for use.
5. Describe the procedures used to inspect, maintain and store hoisting, lifting and rigging equipment.
6. Identify types of knots, hitches, splices and bends and describe their applications and the procedures used to tie them.
7. Describe the considerations when rigging material/equipment for lifting.
  - i) load characteristics
  - ii) working load limit (WLL)
  - iii) equipment and accessories
  - iv) environmental factors
  - v) anchor points
  - vi) sling angles
8. Identify and describe procedures used to communicate during hoisting, lifting and rigging operations.
  - i) hand signals
  - ii) electronic communications
  - iii) audible/visual

Practical Objectives

1. Demonstrate the ability to tie common rigging knots.

## ELE-120                      Support Components

### Learning Outcomes:

- Demonstrate knowledge of interpreting, creating and extracting information from sketches, drawings and specifications.
- Demonstrate knowledge of procedures for fabricating support structures.
- Demonstrate knowledge of brackets, hangers and fasteners, their applications and their use.
- Demonstrate knowledge of measurement and layout techniques.
- Demonstrate knowledge of seismic restraint systems, their applications and their use.

### CEL 2015 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

### Objectives and Content:

#### Theoretical Objectives

1. Create, interpret and extract information pertaining to support structures from sketches, drawings and specifications.
2. Identify support materials, their characteristics and applications.
  - i) wood
  - ii) steel
  - iii) aluminum
3. Describe the procedures used to fabricate support structures.
4. Identify types of brackets, hangers and fasteners and describe their characteristics and applications.

- i) brackets
    - angle
    - T
    - L
    - floor
    - ceiling
  - ii) hangers
    - trapeze
    - pipe clamps
    - beam clamps
  - iii) fasteners
    - spring nuts
    - bolts
    - screws
    - concrete anchors
5. Describe the procedures for securing brackets, hangers and fasteners to structure.
  6. Identify building materials and describe their characteristics and applications.
    - i) steel
    - ii) concrete
    - iii) brick
    - iv) block
    - v) wood
  7. Identify measurement and layout techniques used to ensure brackets, hangers and fasteners are positioned and mounted according to job specifications.
  8. Identify types of seismic restraint systems and describe their characteristics and applications.
    - i) chains
    - ii) cables
    - iii) rods
    - iv) aircraft wires
  9. Describe the procedures used to mount and secure seismic restraint systems to structure.

Practical Objectives:

N/A

## **ELE-125            Trade Documentation**

### **Learning Outcomes:**

- Demonstrate knowledge of trade documentation, its purpose, application and use.

### **CEL 2015 Red Seal Occupational Standard Reference:**

3.05            Finalizes required documentation.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1.        Define terminology associated with trade documentation.
2.        Identify sources of information.
  - i)        regulations
  - ii)       codes
  - iii)      occupational health and safety requirements
  - iv)      authority having jurisdiction (AHJ) requirements
  - v)        prints
  - vi)      drawings
  - vii)     specifications
  - viii)    company and client documentation
3.        Describe and identify types of documentation developed from different tasks.
4.        Describe the procedures for finalizing 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.

### **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 SI (système internationale) units in trade documentation.
- Demonstrate knowledge of interpreting and extracting information from basic drawings, schematics and specifications.

### **CEL 2015 Red Seal Occupational Standard Reference:**

3.01                      Interprets plans, drawings and specifications.

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. 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
2. Interpret imperial and SI units of measure used.
3. 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 division 23
  - specification division 25
  - specification division 26
  - specification division 27
  - specification division 28

4. Explain how scaling is performed to position devices.

Practical Objectives

N/A

## ELE-140

## Worksite Preparation and Organization

### Learning Outcomes:

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

### CEL 2015 Red Seal Occupational Standard Reference:

- 3.02 Organizes materials and supplies.
- 3.04 Prepares worksite.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify sources of information relevant to organizing materials and supplies.
  - i) drawings
  - ii) specifications
  - iii) client requirements
2. Describe the considerations to organize materials and supplies.
  - i) available space
  - ii) schedule
  - iii) storage location
3. Identify sources of information relevant to preparing the worksite.
  - i) drawings
  - ii) specifications
  - iii) authority having jurisdiction (AHJ)
  - iv) client requirements

4. Identify potential hazards relevant to preparing the worksite.
  - i) confined spaces
  - ii) trenches
  - iii) overhead hazards
  - iv) uneven ground
  - v) high traffic area
  - vi) elevated work areas
  
5. Describe the 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, concrete slab on grade and in soil and describe the types of equipment used to locate them.
  - i) conduits
  - ii) heating cables
  - iii) pipes
  - iv) reinforcement bar
  - v) post-tensioned cables
  
7. Describe the safety requirements taken when x-ray surveying equipment is used in occupied buildings.

Practical Objectives:

N/A

## ELE-145            DC Theory

### Learning Outcomes:

- Demonstrate knowledge of direct current (DC) electricity, its hazards, characteristics, and associated principles.
- Demonstrate knowledge of basic electric circuits and their 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 calculations for electricity related values.

### CEL 2015 Red Seal Occupational Standard Reference:

N/A

### Suggested Hours:

30 Hours

### Objectives and Content:

#### 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 characteristics and purpose.
  7. Identify units of measure and symbols pertaining to DC electricity.
  8. Explain Ohm's Law.
  9. Identify the 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 electricity related values in simple circuits.
    - i) voltage
    - ii) current
    - iii) resistance
    - iv) power

Practical Objectives

1. Use instruments to troubleshoot DC components.
  - i) closed circuit
  - ii) open circuit
  - iii) short 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 DC circuit troubleshooting procedures.

### CEL 2015 Red Seal Occupational Standard Reference:

N/A

### Suggested Hours:

30 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with series and parallel 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.

### **CEL 2015 Red Seal Occupational Standard Reference:**

N/A

### **Suggested Hours:**

18 Hours

### **Objectives and Content:**

#### 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 the 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 characteristics and applications.
  - 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 calculations for AC series and parallel circuit values.
- Demonstrate knowledge of calculations for AC three-wire circuit values.
- Demonstrate knowledge of AC circuit troubleshooting procedures.

### CEL 2015 Red Seal Occupational Standard Reference:

N/A

### Suggested Hours:

30 Hours

### Objectives and Content:

#### 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 characteristics and applications.
  - 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 the procedures to locate and interpret information in the Canadian Electrical Code (CEC).

### **CEL 2015 Red Seal Occupational Standard Reference:**

N/A

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### 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. Explain the methods used 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 I**

### **Learning Outcomes:**

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

### **CEL 2015 Red Seal Occupational Standard Reference:**

11.01            Installs grounding and bonding systems.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Interpret codes and regulations pertaining to grounding and bonding.
2. Interpret information pertaining to grounding and bonding found on drawings and specifications.
3. Identify grounding methods.
4. Identify bonding methods.
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. Identify the considerations and requirements for selecting grounding conductors, methods, equipment and components.

8. Identify the considerations and requirements for selecting bonding conductors, methods, equipment and components.
9. Explain the purpose of grounding and bonding, their differences, and identify situations where interconnection of bonding is required.
10. Describe the procedures used to install grounding systems.
11. Describe the methods used to determine grounding conductor size.
12. Describe the procedures used to install bonding systems.
13. Describe the method used to calculate bonding conductor size.

Practical Objectives

N/A

## ELE-175                      Single-Phase Services

### Learning Outcomes:

- Demonstrate knowledge of single-phase services and their applications.
- Demonstrate knowledge of single-phase service installation methods.
- Demonstrate knowledge of grounding and bonding techniques used on sin'
- Demonstrate knowledge of load calculations for single-phase service.
- Demonstrate knowledge of the methods used to service and maintain single-phase services.
- Demonstrate knowledge of the methods used to commission, start-up, shut-down, and decommission single-phase services.

### CEL 2015 Red Seal Occupational Standard Reference:

- 7.01              Installs single-phase consumer/supply services and metering equipment.
- 7.03              Performs servicing and maintenance of single-phase services and metering equipment.
- 5.01              Performs startup and shutdown procedures.
- 5.02              Performs commissioning and decommissioning of systems

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to single-phase services.
2. Interpret information pertaining to single-phase services found on drawings and specifications.
3. 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
4. Identify service components, service conductors and fasteners and describe their purpose and applications.
  5. Identify the considerations and requirements for selecting the type of single-phase services, service components and service conductors.
  6. 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
  7. Describe the procedures used to install single-phase services, service components and service conductors.
  8. Describe the procedures used to connect service conductors.
  9. Identify the methods of grounding and bonding single-phase services.
  10. Identify the methods used to calculate load.
  11. Describe the procedures used to service single-phase services and their components.
  12. Describe the procedures used to maintain, single-phase services and their components.
  13. Describe the procedures used to start-up, shut-down, commission, and decommission single-phase services.

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

### CEL 2015 Red Seal Occupational Standard Reference:

- 9.01 Installs power distribution equipment.
- 9.02 Performs servicing and maintenance of power distribution equipment.
- 5.01 Commissions systems
- 5.02 Performs shutdown and startup procedures

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to single-phase power distribution equipment.
2. Interpret information pertaining to single-phase power distribution equipment found on drawings and specifications.
3. Identify types of single-phase power distribution equipment and describe their characteristics and applications.

4. Identify the considerations and requirements for selecting single-phase power distribution equipment and enclosures.
  - i) load
  - ii) voltage ratings
  - iii) required circuit capacity/amperage ratings
5. Describe the procedures used to install single-phase power distribution equipment.
6. Describe the procedures used to connect single-phase power distribution equipment.
7. Describe the procedures for transporting and moving single-phase electrical equipment.
8. Perform calculations to determine single-phase distribution equipment ratings.
  - i) panels/sub-panels
  - ii) disconnects
  - iii) overcurrent devices
9. Describe the procedures used to service single-phase power distribution equipment and their components.
10. Describe the procedures used to maintain single-phase power distribution equipment and their components.
11. Describe the procedures to commission, startup, shutdown, and decommission single-phase power distribution equipment.
12. Describe the procedures used to start-up, shut-down, commission, and decommission single-phase services.

Practical Objectives

N/A

## **ELE-185                    Conductors and Cables**

### **Learning Outcomes:**

- Demonstrate knowledge of types of conductors and cables and their associated components.
- Demonstrate knowledge of the procedures used to remove and/or install conductors and cables.
- Demonstrate knowledge of the procedures to service cables.
- Demonstrate knowledge of the procedures to maintain cables.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 16.01            Installs conductors and cables.  
16.05            Performs servicing and maintenance of raceways, cables and enclosures.

### **Suggested Hours:**

18 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes, regulations and standards pertaining to conductors and cables.
2. Interpret information pertaining to conductors and cables found on drawings and specifications.
3. Identify types of conductors and cables and describe their characteristics and applications.
4. 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
5. Identify the considerations and requirements for removal of conductors and cables and their associated components.
  6. Identify the considerations and requirements for selecting conductors and cables and their associated components and accessories.
  7. Identify the considerations and requirements for installing conductors and cables and their associated components and accessories.
    - i) conduit fill
    - ii) methods of pulling conductors/cables
    - iii) de-rating factors
    - iv) routing
    - v) location
  8. Describe the procedures used to remove conductors and cables and their associated components.
  9. Describe the procedures used to prepare conductors and cables and their associated components and accessories.
    - i) copper
    - ii) aluminum
  10. Describe the procedures to splice conductors and cables.
  11. Describe the procedures used to terminate conductors and cables.
  12. Describe the procedures to service cables.
  13. Identify the considerations when maintaining cables.
    - i) changes from the original installation
    - ii) heat points
    - iii) physical damage
    - iv) information from end user
    - v) integrity of the insulation
    - vi) tightness of the terminations
    - vii) odours
    - viii) colour

- ix) physical protection
- x) supports
- xi) movement due to temperature or vibration

14. Describe the procedures to maintain cables.

Practical Objectives

1. Install, splice and terminate conductors and cables.

## **ELE-190                    Conduit, Tubing and Fittings**

### **Learning Outcomes:**

- Demonstrate knowledge of types of conduit, tubing and fittings, their components and applications.
- Demonstrate knowledge of the procedures used to remove and/or install conduit, tubing and fittings.
- Demonstrate knowledge of the procedures to maintain conduit, tubing and fittings.

### **CEL 2015 Red Seal Occupational Standard Reference:**

16.02                    Installs conduit, tubing and fittings.

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Interpret codes and regulations pertaining to conduit, tubing and fittings.
2. Interpret information pertaining to conduit, tubing and fittings found on drawings and specifications.
3. Identify tools and equipment related to conduit, tubing and fittings and describe their applications and procedures for use.
4. Identify types of conduit, tubing and fittings and describe their characteristics, applications and limitations.
  - EMT
  - Rigid PVC
  - Flexible conduit
  - Rigid steel
  - ENT
  - DB2

5. Perform calculations to determine conduit size.
6. Identify conduit, tubing and fitting components and describe their characteristics and applications.
7. Identify the considerations and requirements for selecting conduit, tubing and fittings and their associated components.
  - calculate conduit expansion
8. Describe the procedures used for the removal of conduit and tubing.
9. Describe the procedures used to cut, thread (if applicable) and bend conduit and tubing.
10. Describe the procedures used to install and support conduit and tubing systems.
11. Describe the procedures used to select and install conduit and tubing related components.
12. Identify environmental conditions, hazards, incidents, situations and inside/outside conditions that can cause damage in specific types of conduit, tubing, fittings.
13. Identify the 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 to tighten or adjust conduit, tubing, and fittings.
16. Describe the procedures to clean conduit, tubing, and fittings.

### Practical Objectives

1. Cut and bend conduit and tubing.

## **ELE-195                  Raceways**

### **Learning Outcomes:**

- Demonstrate knowledge of types of raceways and their components.
- Demonstrate knowledge of the procedures used to remove and/or install and support raceways.
- Demonstrate knowledge of the procedures to service raceways.
- Demonstrate knowledge of the procedures to maintain raceways.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 16.03                  Installs raceways.  
16.05                  Performs servicing and maintenance of raceways, cables and enclosures.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes, regulations and standards pertaining to raceways.
2. Interpret information pertaining to raceways found on drawings and specifications.
3. 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
  - vii) bus duct
  - viii) cable bus
4. Identify raceway components and describe their characteristics and applications.

- i) fittings
  - ii) supports
  - iii) expansion joints
5. Identify the considerations and requirements for removal of raceways and their components.
  6. Identify the considerations and requirements for selecting raceways and their components.
  7. Describe the procedures used to remove raceways and their components.
  8. Describe the procedures used to install and support raceways and their components.
  9. Identify the considerations when servicing and maintaining raceways.
    - i) changes from original installation
    - ii) heat points
    - iii) physical damage
    - iv) information from end user
  10. Describe the procedures to service and maintain raceways.

Practical Objectives

N/A

## ELE-200                    Boxes and Enclosures

### Learning Outcomes:

- Demonstrate knowledge of boxes and enclosures.
- Demonstrate knowledge of the procedures used to remove and/or install and support boxes and enclosures.
- Demonstrate knowledge of the procedures to service boxes and enclosures.
- Demonstrate knowledge of the procedures to maintain boxes and enclosures.

### CEL 2015 Red Seal Occupational Standard Reference:

- 16.04            Installs boxes and enclosures.  
16.05            Performs servicing and maintenance of raceways, cables and enclosures.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes, regulations and standards pertaining to boxes and enclosures.
2. Interpret information pertaining to boxes and enclosures found on drawings and specifications.
3. Identify types of boxes and enclosures and describe their characteristics and applications.
  - device
  - utility
  - FS/FD
  - masonry
  - square
  - octagon
  - pancake
  - power and communication

- 347 V
  - pull
  - splitter
4. Identify the considerations and requirements for removal of boxes and enclosures.
  5. Identify the 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
  6. Describe the procedures used to remove boxes and enclosures.
  7. Describe the procedures used to install and support boxes and enclosures.
  8. Identify the considerations when servicing and maintaining boxes and enclosures.
  9. Describe the procedures used to service and maintain boxes and enclosures.

Practical Objectives:

N/A

## **ELE-205                      Wiring Devices**

### **Learning Outcomes:**

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

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 17.02              Installs wiring devices.
- 17.05              Performs servicing of branch circuitry.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes, regulations and standards pertaining to wiring devices.
2. Interpret information pertaining to wiring devices found on drawings and specifications.
3. Identify types of wiring devices and describe their applications and operation.
  - i) lampholders
  - ii) switches
  - iv) sensors
  - vii) safety switches
  - viii) power outlets
  - ix) receptacles
4. Identify the considerations and requirements for removal of wiring devices.
5. Identify the considerations and requirements for selection of wiring devices.

6. Describe the procedures used to remove wiring devices.
7. Describe the procedures used to install wiring devices.
8. Describe the procedures used to service and maintain wiring device components.

Practical Objectives

N/A

## **ELE-210                    Luminaires, and Lighting Controls**

### **Learning Outcomes:**

- Demonstrate knowledge of luminaires their applications and operation.
- Demonstrate knowledge of the procedures used to remove and/or install and support luminaires.
- Demonstrate knowledge of types of lighting control components, their applications and operation.
- Demonstrate knowledge of the procedures used to remove and/or install, connect and test lighting control components.
- Demonstrate knowledge of the procedures used to service luminaire and lighting control components.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 17.01            Installs luminaires.
- 17.03            Installs lighting controls.
- 17.05            Performs servicing of branch circuitry.

### **Suggested Hours:**

24 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes, regulations and standards pertaining to lighting systems.
  - i) luminaires
  - ii) lighting controls
  
2. Interpret information pertaining to lighting systems found on drawings and specifications.
  - i) luminaires
  - ii) lighting controls
  
3. Identify types of luminaires and describe their applications and operations.

- i) LED
  - ii) HID
  - iii) low pressure sodium
  - iv) incandescent
  - v) quartz
  - vi) fluorescent
4. Identify hazards and describe safe work practices pertaining to ...
    - i) environmental considerations
  5. Identify luminaire components and describe their characteristics and applications.
  6. Identify the considerations and requirements for selecting luminaires and their components.
  7. Describe the procedures used to remove luminaires and their components.
  8. Describe the procedures used to install and support luminaires and their components.
  9. Describe the procedures used to perform tests related to luminaires.
  10. Identify types of lighting control components and describe their characteristics and applications.
    - i) 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
  11. Identify considerations and requirements for removal and disposal of lighting control components.
  12. Identify considerations and requirements for selecting lighting control components.

13. Describe the procedures used to remove lighting control components.
14. Describe the procedures used to install lighting control components.
15. Describe the procedures used to connect lighting control components.
16. Describe the procedures used to test lighting control components.
17. Describe the procedures used to diagnose luminaire and lighting control components.
18. Describe the procedures used to repair/replace luminaire and lighting control components.
19. Identify electronic components and describe their application as it pertains to luminaires and lighting controls.

*Practical Objectives*

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

## **ELE-215                    Introduction to Communication Systems**

### **Learning Outcomes:**

- Demonstrate knowledge of communication systems, their applications and operation.
- Demonstrate knowledge of the procedures used to install communication systems.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 27.01            Installs voice/data/video (VDV) and community antenna television (CATV) systems.
- 27.02            Installs public address (PA) and intercom systems.
- 27.03            Installs nurse call systems.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### *Theoretical Objectives:*

1. Interpret codes and standards pertaining to communication systems.
2. Interpret information pertaining to communication systems found on drawings and specifications.
3. Identify types of communication systems and describe their basic characteristics and applications.
  - i. voice / data
  - ii. public address
  - iii nurse call
  - iv. intercoms
4. 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
5. Identify the considerations and requirements for selecting basic communication systems and their components.
6. Describe the procedures used to install basic communication systems and their components.
- Shielding

Practical Objectives

N/A

# Level 2

<b>Unit Code</b>	<b>Unit Title</b>	<b>Suggested Hours</b>	<b>Page Number</b>
ELE-220	Job Planning	6	74
ELE-225	Voltage Drop and Power Loss	30	75
ELE-230	Environmental and Hazardous Installations	24	77
ELE-235	DC Generating Systems	12	79
ELE-240	Single-Phase AC Circuits II	27	81
ELE-245	Protective Devices	24	83
ELE-250	Extra-Low Voltage Transformers	6	86
ELE-255	Low-Voltage Single-Phase Transformers	12	88
ELE-260	Renewable Energy and Storage Systems I	9	90
ELE-265	Exit and Emergency Lighting Systems	12	92
ELE-270	Heating, Ventilation and Air-Conditioning Systems	18	94
ELE-275	Heating, Ventilation and Air-Conditioning System Controls	12	96
ELE-280	Electric Heating Systems	12	98
ELE-285	Electric Heating System Controls	12	100
ELE-290	Cathodic Protection Systems	6	102
ELE-295	DC Motors I	12	104
ELE-300	Motor Starters I	6	106
ELE-305	Motor Controls Devices I	12	108
ELE-310	Drawings, Schematics and Specifications II	12	110
ELE-315	Lightning Protection Systems	6	112

## ELE-220            **Job Planning**

### **Learning Outcomes:**

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

### **CEL 2015 Red Seal Occupational Standard Reference:**

3.03            Plans project tasks and procedures.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Identify sources of information relevant to planning job tasks and procedures.
  - i) drawings
  - ii) specifications
  - iii) client requirements
  
2. Describe the considerations to plan and organize job tasks and procedures.
  - i) available space
  - ii) scheduling/sequencing
  - iii) permits
  - iv) hazard assessment
  - v) personnel
  - vi) tools and equipment
  - vii) materials and supplies
  - viii) storage location / laydown area
  
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.

### **CEL 2015 Red Seal Occupational Standard Reference:**

N/A

### **Suggested Hours:**

30 Hours

### **Objectives and Content:**

#### Theoretical Objectives

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

10. Interpret codes and regulations pertaining to voltage drop and 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 hazardous locations.
- Demonstrate knowledge of hazardous locations wiring methods.
- Demonstrate knowledge of the procedures used to service and maintain equipment and components in hazardous locations.

### CEL 2015 Red Seal Occupational Standard Reference:

16.06 Maintains conduit, tubing, fittings, raceways, boxes and enclosures

### Suggested Hours:

24 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to electrical installations in hazardous locations.
2. Interpret information pertaining to electrical installations in hazardous locations found on drawings and specifications.
3. Identify types of environmental conditions and describe safe work procedures.
  - i) wet
  - ii) dusty
  - iii) corrosive
  - iv) hot
  - v) cold
4. Identify equipment designed for installation and operation in areas according to environmental conditions.

5. Identify and describe wiring procedures and methods for areas according to environmental conditions.
6. Identify types of hazardous locations and describe their characteristics.
  - i) explosive gas
  - ii) explosive and combustible dust
  - iii) combustible fibres and flyings
7. Identify types of potentially hazardous materials present and the procedures to designate an area to be a hazardous location.
8. Identify equipment and fittings designed for installation and operation in hazardous locations.
  - i) boxes and enclosures
  - ii) cables and conductors
  - iii) conduits, tubing and fittings
  - iv) motors and motor control devices
  - v) lighting equipment and controls
  - vi) wiring devices
  - vii) raceways
9. Identify and describe wiring methods for use in hazardous locations.
10. Describe the procedures used to install and connect electrical components, devices and equipment in hazardous locations.
11. Describe the procedures used to service electrical components, devices and equipment in hazardous locations.
12. Describe the procedures used to maintain electrical components, devices and equipment in hazardous locations.

Practical Objectives:

N/A

## ELE-235            DC Generating Systems

### Learning Outcomes:

- Demonstrate knowledge of DC generating systems and DC generating system components, their applications and operation.
- Demonstrate knowledge of the procedures used to install and connect DC generating systems.
- Demonstrate knowledge of the procedures used to service and maintain DC generating systems.

### CEL 2015 Red Seal Occupational Standard Reference:

- 12.03            Installs direct current (DC) generating systems.  
12.04            Performs servicing and maintenance of DC generating systems.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes, standards and regulations pertaining to DC generating systems.
2. Interpret information pertaining to DC generating systems found on drawings and specifications.
3. Identify types of DC generating systems and explain their operating principles.
  - i) portable
  - ii) stationary
  - iii) manually operated
  - iv) automatically operated
4. Identify types of DC generators and describe their characteristics and applications.
  - i) series
  - ii) shunt

- iii) compound
5. Identify DC generating 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
  6. Identify the considerations and requirements for selecting DC generating systems and DC generating components.
  7. Describe the procedures used to install DC generating systems and DC generating system components.
  8. Describe the procedures used to connect DC generating systems and DC generating components.
    - i) floating ground
  9. Describe the procedures used to control the output voltage of DC generators.
  10. Describe the procedures used to service DC generating systems and DC generating system components.
  11. Describe the procedures used to maintain DC generating systems and DC generating system components.
  12. Identify electronic components and describe their application as it pertains to DC generating 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.

### CEL 2015 Red Seal Occupational Standard Reference:

N/A

### Suggested Hours:

27 Hours

### Objectives and Content:

#### 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 reactance
    - capacitive reactance
  - iii) impedance
3. Explain the effects of electrical components found in parallel AC circuits.
  - i) resistance
  - ii) reactance
    - inductive reactance
    - capacitive reactance
  - iii) impedance
4. Perform calculations to determine series and parallel AC circuit related values.
  - i) inductance 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                    Protective Devices**

### **Learning Outcomes:**

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

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 8.01 Installs overcurrent protection devices.
- 8.02 Installs ground fault, arc fault and surge protection devices.
- 8.03 Performs servicing and maintenance of ground fault, arc fault and surge protection devices.

### **Suggested Hours:**

24 Hours

### **Objectives and Content:**

#### Theoretical Objectives

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

2. Interpret information pertaining to protective 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
3. Explain the purpose of updating required documentation.
  - i) as-builts
  - ii) schematics
  - iii) panel schedules
  - iv) log sheets
  - v) drive drawings
  - vi) shop drawings
4. Explain the purpose and operation of overcurrent devices.
5. Explain the effects of short-circuit current and describe the associated damage to the circuit.
6. Identify types of overcurrent devices and describe their characteristics and applications.
  - i) fuses
  - ii) breakers
  - iii) relay protection
7. Identify the considerations and requirements for selecting overcurrent devices.
8. Explain the purpose of coordination studies.
9. Describe the procedures used to install overcurrent devices.
10. Describe the procedures used to adjust trip settings.
11. Explain the purpose and operation of ground fault, arc fault and surge protection devices.
12. Identify types of ground fault, arc fault and surge protection devices.

- i) ground fault
    - GFCI receptacle
    - breaker
  - ii) arc fault
    - AFCI receptacle
    - breaker
  - iii) surge protection
    - MOV
    - zener diodes
    - thyristors
    - surge suppressors
13. Identify the considerations and requirements for selecting ground fault, arc fault and surge protection devices.
  14. Describe the procedures used to install ground fault, arc fault, and surge protection devices.
  15. Explain the purpose and operation of under and over voltage protection devices.
  16. Identify types of under and over voltage protection devices.
    - i) under voltage
    - ii) over voltage
  17. Identify the considerations and requirements for selecting under and over voltage protection devices.
  18. Describe the procedures used to install under and over voltage protection devices.
  19. Describe the procedures used to service protective devices.
  20. Describe the procedures used to maintain protective devices.
  21. 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, their applications and operation.
- Demonstrate knowledge of the procedures used to install extra-low voltage transformers.
- Demonstrate knowledge of the procedures used to service and maintain extra-low voltage transformers.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 15.01            Installs extra-low voltage transformers.  
15.05            Performs servicing and maintenance of transformers.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret information contained on extra-low voltage transformer nameplates.
2. Explain the operating principles of extra-low voltage transformers.
3. 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)
4. Identify extra-low voltage transformer components and describe their characteristics and applications.
  - i) casing
  - ii) core
  - iii) primary windings
  - iv) secondary windings

5. Identify the considerations and requirements for selecting extra-low voltage transformers.
6. Describe the procedures used to install extra-low voltage transformers.
7. Describe the procedures used to service extra-low voltage transformers and their components.
8. 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, their applications and operation.
- Demonstrate knowledge of the procedures used to install low-voltage single-phase transformers.
- Demonstrate knowledge of the procedures used to service and maintain low-voltage single-phase transformers.

### CEL 2015 Red Seal Occupational Standard Reference:

- 15.02            Installs low-voltage single-phase transformers.  
15.05            Performs servicing and maintenance of transformers.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret information contained on low-voltage single-phase transformer nameplates.
2. Interpret codes and regulations pertaining to low-voltage single-phase transformers.
3. Explain the operating principles of low-voltage single-phase transformers.
4. Explain transformer polarity and terminal markings.
5. Identify types of low-voltage single-phase transformers and describe their characteristics and applications.
  - i) dry-type
  - ii) liquid-filled
  - iii) isolation

- iv) step-down, step-up
  - v) auto
6. Identify low-voltage single-phase transformer components and describe their characteristics and applications.
    - i) ventilation fans
    - ii) casings and enclosures
    - iii) core
    - iv) primary windings
    - v) secondary windings
  7. Identify the considerations and requirements for selecting low-voltage single-phase transformers.
  8. Describe the procedures used to install low-voltage single-phase transformers.
  9. Describe the procedures used to install low-voltage single-phase transformers in parallel.
  10. Describe the procedures used to ground low-voltage transformers.
  11. Describe the procedures used to service low-voltage single-phase transformers and their components.
  12. 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 systems, their applications and operation.
- Demonstrate knowledge of the procedure to install and connect renewable energy systems and control system components.

### CEL 2015 Red Seal Occupational Standard Reference:

13.01                      Installs renewable energy systems.

### Suggested Hours:

9 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with renewable energy generating systems.
2. Interpret codes and regulations pertaining to renewable energy generating systems.
3. Identify types of renewable energy generating systems and describe their characteristics, applications and operation.
  - i) wind turbines
  - ii) photovoltaic modules
4. Identify renewable energy generating system components and describe their characteristics, applications.
5. Identify types of renewable energy generating storage system components.
  - i) pumped hydro
  - ii) compressed air energy storage
  - iii) batteries (various technologies)

6. Describe the procedures used to ground renewable energy systems and their components.
7. Describe the procedures used to connect renewable energy systems and control system components.
8. Identify electronic components and describe their application as it pertains to renewable energy 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 the procedures used to remove and/or install, exit and emergency lighting systems and their components.
- Demonstrate knowledge of the procedures used to service exit and emergency lighting systems.
- Demonstrate knowledge of the procedures used to maintain exit and emergency lighting systems.

### CEL 2015 Red Seal Occupational Standard Reference:

- 20.01 Install exit and emergency lighting.
- 20.02 Performs servicing and maintenance of exit and emergency lighting systems.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes, regulations and standards pertaining to exit and emergency lighting systems.
  - i) Canadian Electrical Code requirements
  - ii) National Building Code requirements
2. Interpret information pertaining to exit and emergency lighting systems found on drawings and specifications.
3. Identify types of exit and emergency lighting systems and describe their applications and operation.
  - i) self-contained
  - ii) central-powered

- iii) remote lighting units
4. Identify exit and emergency lighting system components and describe their characteristics and applications.
  5. Identify the considerations and requirements for removal and disposal of exit and emergency lighting systems and their components.
  6. Identify the considerations and requirements for selecting exit and emergency lighting systems and their components.
  7. Describe the procedures used to remove exit and emergency lighting systems and their components.
  8. Describe the procedures used to install exit and emergency lighting systems and their components.
  9. Describe the procedures used to test exit and emergency lighting systems and their components and complete the required documentation.
  10. Describe the procedures used to diagnose exit and emergency lighting systems and their components.
  11. Describe the procedures used to repair/replace exit and emergency lighting systems and their components.
  12. Describe the procedures used to maintain exit and emergency lighting systems and their components.
  13. Identify electronic components and describe their application as it pertains to exit and emergency lightning 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 the procedures used to disconnect and/or connect HVAC systems.
- Demonstrate knowledge of the procedures used to service electrical components of HVAC systems and heat pumps.
- Demonstrate knowledge of the procedures used to maintain electrical components of HVAC systems.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 18.01            Connects HVAC systems.  
18.03            Performs servicing and maintenance of HVAC systems and controls.

### **Suggested Hours:**

18 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes, standards and regulations pertaining to HVAC systems.
2. Interpret information pertaining to HVAC systems found on drawings and specifications.
3. Explain the principles of heat transfer.
  - i) radiation
  - ii) conduction
  - iii) convection
4. Identify types of HVAC systems and describe their characteristics and applications.
  - i) boilers
  - ii) furnaces

- iii) heat pumps
  - iv) chiller systems
  - v) cooling tower
  - ix) hot water heater
5. Identify the considerations and requirements for disconnecting electrical components of HVAC systems.
  6. Identify the considerations and requirements for connecting electrical components of HVAC systems.
  7. Describe the procedures used to connect electrical components of HVAC systems and heat pumps.
  8. Describe the procedures used to disconnect electrical components of HVAC systems and heat pumps.
  9. Describe the procedures used to diagnose electrical components of HVAC systems and heat pumps.
  10. Describe the procedures used to repair electrical components of HVAC systems and heat pumps.
  11. Describe the procedures used to maintain electrical components of HVAC systems and heat pumps.
  12. Identify electronic components and describe their application as it pertains to heating, ventilation and air-conditioning systems.

Practical Objectives

N/A

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

### **Learning Outcomes:**

- Demonstrate knowledge of types of heating, ventilation and air-conditioning (HVAC) control components, their applications and operation.
- Demonstrate knowledge of the procedures used to remove and/or install, connect, and test HVAC control components.
- Demonstrate knowledge of the procedures used to service HVAC control components.
- Demonstrate knowledge of the procedures used to maintain HVAC control components.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 18.02            Installs HVAC controls.  
18.03            Performs servicing and maintenance of HVAC systems and controls.

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to HVAC control components.
2. Interpret information pertaining to HVAC control components found on drawings and specifications.
3. Identify types of HVAC control components and describe their characteristics and applications.
  - i) time clocks
  - ii) relays
  - iii) thermostats
  - iv) sensors
  - v) actuators

- vi) electrical interlocks
  - vii) multiple function controllers
  - viii) VFDs
4. Identify the considerations and requirements for removal of HVAC control components.
  5. Identify considerations and requirements for selecting HVAC control components.
  6. Describe the procedures used to remove HVAC control components.
  7. Describe the procedures used to install HVAC control components.
  8. Describe the procedures used to connect HVAC control components.
  9. Describe the procedures used to test HVAC control components.
  10. Describe the procedures used to diagnose HVAC controls and their components.
  11. Describe the procedures used to repair HVAC controls and their components.
  12. Describe the procedures used to maintain HVAC controls and their components.
  13. Identify electronic components and describe their application as it pertains to heating, ventilation and air-conditioning 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 the procedures used to remove and/or install electric heating systems.
- Demonstrate knowledge of the procedures used to service electric heating systems.
- Demonstrate knowledge of the procedures used to maintain electric heating systems.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 19.01                  Installs electric heating systems.
- 19.03                  Performs servicing and maintenance of electric heating systems and controls.

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Interpret codes and regulations pertaining to electric heating systems.
2. Interpret information pertaining to electric heating systems found on drawings and specifications.
3. Identify types of electric heating systems and describe their applications and operation.
  - i) electric forced air furnace
  - ii) electric boiler
  - iii) convection heaters
  - iv) radiant heaters

- v) heat tracing cables
  - vi) duct heaters
  - vii) heating cables
  - viii) electric hot water radiation furnace
4. Identify electric heating system components and describe their characteristics and applications.
  5. Identify the considerations and requirements for removal of electric heating systems and their components.
  6. Identify the considerations and requirements for selecting electric heating systems and their components.
  7. Describe factors that contribute to basic heat loss.
  8. Perform calculations to determine heating requirements.
  9. Describe the procedures used to remove electric heating systems and their components.
  10. Describe the procedures used to install electric heating systems and their components.
  11. Describe the procedures used to diagnose electric heating systems.
  12. Describe the procedures used to repair electric heating systems.
  13. Describe the procedures used to maintain electric heating systems.
  14. 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 the procedures used to remove and/or install electric heating system control components.
- Demonstrate knowledge of the procedures used to service electric heating system control components.
- Demonstrate knowledge of the procedures used to maintain electric heating system control components.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 19.02            Installs electric heating system controls.
- 19.03            Performs servicing and maintenance of electric heating systems and controls.

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to electric heating system control components.
2. Interpret information pertaining to electric heating system control components found on drawings and specifications.
3. 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
4. Identify the considerations and requirements for removal of electric heating system control components.
  5. Identify the considerations and requirements for selecting electric heating system control components.
  6. Describe the procedures used to remove electric heating system control components.
  7. Describe the procedures used to install electric heating system control components.
  8. Describe the procedures used to connect electric heating system control components.
  9. Describe the procedures used to test electric heating system control components.
  10. Describe the procedures used to diagnose electric heating system control components.
  11. Describe the procedures used to repair electric heating system control components.
  12. Describe the procedures used to maintain electric heating system control components.
  13. 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 the procedures used to install, connect and test cathodic protection systems.
- Demonstrate knowledge of the procedures used to service and maintain cathodic protection systems.

### CEL 2015 Red Seal Occupational Standard Reference:

- 21.01            Installs cathodic protection systems.  
21.02            Performs servicing and maintenance of cathodic protection systems.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to cathodic protection systems.
2. Interpret information pertaining to cathodic protection systems found on drawings and specifications.
3. Identify types of cathodic protection systems and describe their characteristics, applications and operation.
  - i) active rectifier
  - ii) sacrificial anode
4. 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
5. Describe the procedures used to install and connect cathodic protection systems and their components.
  6. Describe the procedures used to test cathodic protection systems and their components.
  7. Describe the procedures used to diagnose and repair cathodic protection systems.
  8. Describe the procedures used to maintain cathodic protection systems.
  9. 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 procedures for use.

### CEL 2015 Red Seal Occupational Standard Reference:

24.05            Installs DC motors.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### 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 and applications.
  - i) self-excited
  - ii) separately excited
  - iii) series
  - iv) shunt
  - v) compound
4. Identify components used in the construction of DC motors and describe their characteristics and applications.
  - 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 the considerations and requirements for selecting DC motors and controls and their components.

Practical Objectives:

N/A



## **ELE-300            Motor Starters I**

### **Learning Outcomes:**

- Demonstrate knowledge of motor starters and controllers and their applications.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot, maintain, repair and test motor starters and controllers.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 22.01            Installs motor starters.
- 22.02            Performs servicing and maintenance of motor starters.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Identify hazards and describe safe work practices pertaining to single phase motor starters.
2. Interpret codes and regulations pertaining to single phase motor starters.
3. Interpret information pertaining to single phase motor starters found on motor nameplate, drawings and specifications.
4. Identify types of single phase motor starters and describe their characteristics and applications.
  - i) manual
  - ii) magnetic
5. Describe starting methods and their applications.
  - i) full voltage
6. Describe the procedures used to install single phase motor starters, their components and accessories.
  - i) manual

- ii) magnetic
- 7. Describe the procedures used to connect single phase motor starters, their components and accessories.
- 8. Identify enclosures and wiring methods based on application.
- 9. Describe the procedures used to service single phase motor starters, their components and accessories.
- 10. Describe the procedures used to maintain single phase motor starters, their components and accessories.

Practical Objectives:

N/A

## **ELE-305                    Motor Control Devices I**

### **Learning Outcomes:**

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

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 22.03            Installs motor controls.
- 22.04            Performs servicing and maintenance of motor controls.

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to basic motor control circuits and devices.
2. Interpret information pertaining to basic motor control devices found on drawings and specifications.
3. Describe basic motor control devices and their applications.
  - i) emergency stop stations
  - ii) start/stop stations
4. 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)
5. Describe circuit functional features of basic hard wired motor control circuits.

- i) starting and stopping
  - ii) jogging
6. Identify the methods used to determine the number of conductors required between basic controls and controller locations.
  7. Describe the procedures used to service basic motor control devices and their components.
  8. Describe the procedures used to maintain basic motor control devices and their components.

Practical Objectives:

N/A

## ELE-310

## Drawings, Schematics and Specifications II

### Learning Outcomes:

- Demonstrate knowledge of advanced drawings, schematics and specifications.
- Demonstrate knowledge of the procedures used to interpret advanced drawings, schematics and specifications.
- Demonstrate knowledge of the procedures and requirements to document changes to equipment and wiring.

### CEL 2015 Red Seal Occupational Standard Reference:

3.01            Interprets plans, drawings and specifications.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### 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-315                    Lightning Protection Systems**

### **Learning Outcomes:**

- Demonstrate knowledge of lightning protection systems and their operation.
- Demonstrate knowledge of lightning protection system installation methods.
- Demonstrate knowledge of the methods used to service and maintain lightning protection systems.

### **CEL 2015 Red Seal Occupational Standard Reference:**

11.03                    Installs lightning protection systems.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to lightning protection systems.
2. Interpret information pertaining to lightning protection systems found on drawings and specifications.
3. Identify types of lightning protection systems and describe their characteristics and applications.
  - i) lightning arrester protection
  - ii) structure protection
4. Identify lightning protection system components and describe their purpose and applications.
  - i) lightning rod (air terminal)
  - ii) intercepting conductors
  - iii) down conductors
  - iv) ground electrodes (ground rods)
    - a) off-grid
    - b) grid-tie

- v) supports
  - vi) lightning arresters
5. Explain the purpose of lightning protection systems.
  6. Identify the considerations and requirements for selecting the type of lightning protection systems.
  7. Describe the procedures used to install lightning protection systems and lightning protection system components.
  8. Describe the methods used to service lightning protection systems and their components.
  9. Describe the methods used to maintain lightning protection systems and their components.

Practical Objectives:

N/A

# Level 3

<b>Unit Code</b>	<b>Unit Title</b>	<b>Suggested Hours</b>	<b>Page Number</b>
ELE-320	Three-Phase Theory	30	115
ELE-325	Ground Fault Detection Systems I	12	117
ELE-330	Three-Phase Services	12	119
ELE-335	Three-Phase Distribution Equipment	18	121
ELE-340	AC Generating Systems	18	124
ELE-345	Low-Voltage Three-Phase Transformers	18	126
ELE-350	High Voltage Transformers	12	128
ELE-355	Motor Starters II	18	130
ELE-360	Motor Control Devices II	24	132
ELE-365	Single-Phase Motors I	18	134
ELE-370	Three-Phase Motors I	18	136
ELE-375	DC Motors II	12	138
ELE-380	AC Drives	18	140
ELE-385	DC Drives	12	142

## **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.

### **CEL 2015 Red Seal Occupational Standard Reference:**

N/A

### **Suggested Hours:**

30 Hours

### **Objectives and Content:**

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

8. Perform calculations for balanced and unbalanced loads.
9. 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 Detection Systems I

### Learning Outcomes:

- Demonstrate knowledge of ground fault detection systems installation methods and their operation.
- Demonstrate knowledge of ground fault detection systems installation methods.

### CEL 2015 Red Seal Occupational Standard Reference:

11.02 Installs ground fault systems.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to ground fault detection systems.
2. Interpret information pertaining to ground fault detection systems found on drawings and specifications.
3. Identify types of ground fault detection systems and describe their characteristics and applications.
  - i) ground fault protection (solidly grounded systems)
  - ii) ground fault protection (impedance grounded systems)
  - iii) ground fault detection (ungrounded systems)
4. Explain the purpose of ground fault detection systems.
5. Identify the considerations and requirements for selecting the type of ground fault detection system components.
  - i) CTs
  - ii) resistors
  - iii) relays
  - iv) annunciators (horns, panels)

- v) indicators (pilot lights)
  - vi) reset buttons
  - vii) breakers
  - viii) interconnecting wiring
  - ix) ground fault sensors (direct, residual or zero sequence)
6. Describe the procedures used to install ground fault **s** detection systems and ground fault system components.
7. Identify electronic components and describe their application as it pertains to ground fault 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 the procedures used to install three-phase services.
- Demonstrate knowledge of load calculations for three-phase services.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 7.02            Installs three-phase consumer/supply services and metering equipment.  
7.04            Performs servicing and maintenance of three-phase services and metering equipment.

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Interpret codes and regulations pertaining to three-phase services.
2. Interpret information pertaining to three-phase services found on drawings and specifications.
3. Identify sources of information and documentation required for the installation of three-phase services.
4. Identify types of three-phase services and describe their characteristics and applications.
  - i) temporary service
  - ii) overhead
  - iii) underground
  - iv) single and multiple metering
5. Identify three-phase service components, service conductors and fasteners and describe their purpose and applications.

6. Identify the considerations and requirements for selecting the type of three-phase services, service components and service conductors.
7. Describe the procedures used to install three-phase services service components and service conductors.
8. Describe the procedures used to connect service conductors.
9. Identify the methods of grounding and bonding three-phase services.
10. Describe the applications of ground fault and ground detection type protection systems.
11. Identify the method used to calculate load.
  - i) balanced
  - ii) un-balanced
12. Describe the procedures used to service three-phase services and their components.
13. 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 power distribution equipment, their applications and operation.
- Demonstrate knowledge of the procedures used to install power distribution equipment.
- Demonstrate knowledge of calculations for three-phase distribution equipment ratings.
- Demonstrate knowledge of the procedures used to service and maintain power distribution equipment.
- Demonstrate knowledge of the methods used to commission, start-up, shut-down, and decommission three-phase low voltage power distribution equipment.

### CEL 2015 Red Seal Occupational Standard Reference:

- 9.01 Installs power distribution equipment.
- 9.02 Performs servicing and maintenance of power distribution equipment.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to three-phase power distribution equipment.
2. Interpret information pertaining to three-phase power distribution equipment found on drawings and specifications.
3. Identify types of three-phase power distribution equipment and describe their characteristics and applications.
  - i) panels
  - ii) sub-panels

- iii) PDCs
  - iv) switchboards
  - v) breakers
  - vi) fuses
  - vii) disconnects
  - viii) racking equipment
  - ix) CTs
  - x) PTs
  - xi) busbars
  - xii) splitters
  - xiii) MCCs
4. Identify the considerations and requirements for selecting three-phase power distribution equipment and enclosures.
    - i) load
    - ii) voltage ratings
    - iii) required circuit capacity/amperage ratings
  5. Describe the procedures used to install three-phase power distribution equipment.
  6. Describe the procedures used to connect three-phase power distribution equipment.
  7. Describe the procedures for transporting and moving three-phase power distribution equipment.
  8. Perform calculations to determine three-phase distribution equipment ratings.
    - i) panels/sub-panels
    - ii) disconnects
    - iii) overcurrent devices
  9. Describe the procedures used to service three-phase power distribution equipment and their components.
  10. Describe the procedures used to maintain three-phase power distribution equipment and their components.
  11. Describe the procedures to commission, startup, shutdown, and decommission three-phase power distribution equipment.

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

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 12.01            Installs alternating current (AC) generating systems.  
12.02            Performs servicing and maintenance of AC generating systems.

### **Suggested Hours:**

18 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes, standards and regulations pertaining to AC generating systems.
2. Interpret information pertaining to AC generating systems found on drawings and specifications.
3. Describe the components of AC generating systems and explain their operating principles.
4. Identify types of AC generating systems and describe their characteristics and applications.
  - i) single-phase
  - ii) three-phase
  - iii) portable
  - iv) stationary
  - v) manually operated

- vi) automatically operated
- 5. Identify AC generating system components and describe their characteristics and applications.
- 6. Identify the considerations and requirements for selecting AC generating systems and AC generating system components.
- 7. Describe the procedures used to install AC generating systems and AC generating components.
- 8. Describe the procedures used to connect AC generating systems and AC generating system components.
  - i) floating ground
- 9. Describe the procedures used to parallel/synchronize AC generators.
- 10. Describe the procedures used to control the output voltage, phase sequencing and frequency of AC generators.
- 11. Describe the procedures used to service AC generating systems and their components.
- 12. Describe the procedures used to maintain AC generating systems and their components.
- 13. Identify electronic components and describe their application as it pertains to 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 the procedures used to install low-voltage three-phase transformers.
- Demonstrate knowledge of the procedures used to service and maintain low-voltage three-phase transformers.

### CEL 2015 Red Seal Occupational Standard Reference:

- 15.03            Installs low-voltage three-phase transformers.  
15.05            Performs servicing and maintenance of transformers.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret information contained on low-voltage three-phase transformer nameplates.
2. Interpret codes and regulations pertaining to low-voltage three-phase transformers.
3. Explain the operating principles of low-voltage three-phase transformers.
4. Explain transformer polarity and terminal markings.
5. Identify types of low-voltage three-phase transformers and describe their characteristics and applications.
  - i) dry-type
  - ii) liquid-filled

6. Identify low-voltage three-phase transformer components and describe their characteristics and applications.
  - i) ventilation fans
  - ii) casing
  - iii) core
  - iv) primary windings
  - v) secondary windings
  - vi) oil
  
7. 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/tee
  
8. Identify the considerations and requirements for selecting low-voltage three-phase transformers.
  
9. Describe the procedures used to install low-voltage three-phase transformers.
  
10. Describe the procedures used to ground low-voltage transformers.
  
11. Describe the procedures used to install low-voltage three-phase transformers in parallel.
  
12. Describe the procedures used to service low-voltage three-phase transformers and their components.
  
13. 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 the procedures used to install high voltage transformers.
- Demonstrate knowledge of the procedures used to service and maintain high voltage transformers.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 15.04            Installs high voltage transformers.  
15.05            Performs servicing and maintenance of transformers.

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret information contained on high voltage transformer nameplates.
2. Interpret codes and regulations pertaining to high voltage transformers.
3. Explain the operating principles of high voltage transformers.
4. Explain transformer polarity and terminal markings.
5. Identify types of high voltage transformers and describe their characteristics and applications.
  - i) dry-type
  - ii) liquid-filled
6. 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 tap changers
  - xi) off-line tap changers
  - xii) oil
  - xiii) monitoring devices
7. 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
8. Identify the considerations and requirements for selecting high voltage transformers.
9. Describe the procedures used to install high voltage transformers.
10. Describe the procedures used to ground high voltage transformers.
11. Describe the procedures used to install high voltage transformers in parallel.
12. Describe the procedures used to service high voltage transformers and their components.
13. 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 and their applications.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot, maintain, repair and test motor starters and controllers.

### **CEL 2015 Red Seal Occupational Standard Reference:**

22.03            Installs motor controls

22.04            Performs servicing and maintenance of motor controls

### **Suggested Hours:**

18 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Identify hazards and describe safe work practices pertaining to motor starters and controllers.
2. Interpret codes and regulations pertaining to motor starters and controllers.
3. Interpret information pertaining to motor starters and controllers found on drawings and specifications.
4. 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) soft starters
  - vi) reduced-voltage starters
5. 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
6. Identify types of motor controllers and describe their characteristics and applications.
- i) wound rotor motor controller
  - ii) multi-speed controller
  - iii) frequency drives
7. Identify motor controller components and accessories and describe their characteristics and applications.
8. Identify types of motor control centers and describe their characteristics and applications.
9. Identify motor control center components and accessories and describe their characteristics and applications.
10. Describe the procedures used to install and connect motor starters and motor controllers, their components and accessories.
11. Describe the procedures used to troubleshoot motor starters and motor controllers, their components and accessories.
12. Describe the procedures used to maintain, repair and test motor starters and motor controllers, their components and accessories.
13. 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 and their applications.
- Demonstrate knowledge of motor control circuits, their characteristics and applications.
- Demonstrate knowledge of the procedures used to service and maintain motor control devices.

### CEL 2015 Red Seal Occupational Standard Reference:

- 22.03            Installs motor controls.  
22.04            Performs servicing and maintenance of motor controls.

### Suggested Hours:

24 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to motor control circuits and devices.
2. Interpret information pertaining to motor control devices found on drawings and specifications.
3. Describe motor control devices and their applications.
  - 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
    - timers

- on-delay
  - off-delay
4. 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
  5. Identify the methods used to determine the number of conductors required between controls and controller locations.
  6. 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
  7. Describe the procedures used to service motor control devices and their components.
  8. Describe the procedures used to maintain motor control devices and their components.
  9. Identify electronic components and describe their application 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 the procedures used to install and connect single-phase motors.
- Demonstrate knowledge of calculations for single-phase motor conductors and protection devices.

### **CEL 2015 Red Seal Occupational Standard Reference:**

24.01            Installs single-phase motors.

### **Suggested Hours:**

18 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Interpret codes and regulations pertaining to single-phase motors.
2. Interpret information pertaining to single-phase motors found on drawings and specifications.
3. Interpret information contained on single-phase motor nameplates.
4. Identify types of single-phase motors and describe their characteristics.
  - i) hermetically sealed
  - ii) dual capacitor
  - iii) reluctance
  - iv) capacitor start/induction run
  - v) split phase
  - vi) universal
  - vii) resistance split phase
  - viii) permanent split capacitor

- ix) shaded pole
5. 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
  6. Explain the construction and operating principles of single-phase motors.
  7. 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
  8. Identify the considerations and requirements for selecting single-phase motors and their components.
  9. Describe the procedures used to install single-phase motors.
  10. Describe the procedures used to connect single-phase motors.
  11. 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 and procedures for use.
- Demonstrate knowledge of the procedures used to install and connect three-phase motors.
- Demonstrate knowledge of calculations for three-phase motor conductors and protection devices.

### **CEL 2015 Red Seal Occupational Standard Reference:**

24.03            Installs three-phase motors.

### **Suggested Hours:**

18 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Interpret codes and regulations pertaining to three-phase motors.
2. Interpret information pertaining to three-phase motors found on drawings and specifications.
3. Interpret information contained on motor nameplates.
4. Explain the construction and operating principles of three-phase motors.
5. Identify types of three-phase motors and describe their characteristics.
  - i) squirrel cage induction
  - ii) wound rotor induction
  - iii) synchronous
  - iv) linear induction
6. Identify three-phase motor components and describe their applications.

7. 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
8. Identify the considerations and requirements for selecting three-phase motors and their components.
9. Describe the procedures used to install three-phase motors.
10. Describe the procedures used to connect three-phase motors.
11. 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 the procedures used to install and connect DC motors.
- Demonstrate knowledge of calculations for DC motor conductors and protection devices.

### CEL 2015 Red Seal Occupational Standard Reference:

24.05 Installs DC motors.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to DC motors.
2. Interpret information pertaining to DC motors found on drawings and specifications.
3. Interpret information contained on motor nameplates.
4. Describe the procedures used to install DC motors and controls and their components.
5. Describe the procedures used to connect DC motors and controls and their components.
6. 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 the procedures used to install and connect AC drives.
- Demonstrate knowledge of the procedures used to service and maintain AC drives.

### CEL 2015 Red Seal Occupational Standard Reference:

- 23.01            Installs AC drives.  
23.02            Performs servicing and maintenance of AC drives.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and regulations 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) EMC filters
  - iii) DC circuits
  - iv) inverters
5. Explain the operating principles of AC drives and their impact on motor performance.

6. Identify the considerations and requirements for selecting AC drives, their components and accessories.
7. Describe the procedures used to install AC drives, their components and accessories.
8. Describe the procedures used to connect AC drives, their component and accessories.
9. Describe the procedures used to configure AC drives, their components and accessories.
10. Describe the procedures used to service and maintain AC drives, their components and accessories.
11. Identify electronic components and describe their application as it pertains to AC drives.

*Practical Objectives*

1. Connect, configure and operate AC drives.

## **ELE-385            DC Drives**

### **Learning Outcomes:**

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

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 23.03            Installs DC drives.  
23.04            Performs servicing and maintenance of DC drives.

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Interpret codes and regulations pertaining to DC drives.
2. Interpret information pertaining to DC drives found on drawings and specifications.
3. Identify types of DC drives and describe their characteristics, applications and operation.
4. Identify DC drive components and accessories and describe their characteristics, applications and operation.
  - i) converters
  - ii) regulators
5. Explain the operating principles of DC drives and their impact on motor performance.

6. Identify the considerations and requirements for selecting DC drives, their components and accessories.
7. Describe the procedures used to install DC drives, their components and accessories.
8. Describe the procedures used to connect DC drives, their component and accessories.
9. Describe the procedures used to configure DC drives, their components and accessories.
10. Describe the procedures used to service and maintain DC drives, their components and accessories.
11. Identify electronic components and describe their application as it pertains to DC drives.

Practical Objectives:

N/A

# Level 4

Unit Code	Unit Title	Suggested Hours	Page Number
MENT-701	Mentoring II	6	147
CEL-405	Grounding and Bonding Systems II	6	149
CEL-410	Power Conditioning, Uninterruptible Power Supply (UPS) and Surge Suppression Systems	12	150
CEL-415	High Voltage Equipment	12	152
CEL-420	High Voltage Cables	12	155
CEL-425	Renewable Energy and Storage Systems II	12	157
CEL-430	Lighting Standards	6	159
CEL-435	Airport Runway Lighting Systems and Controls	6	161
CEL-440	Traffic Signal Lights and Controls	6	163
CEL-445	Single-Phase Motors II	6	165
CEL-450	Three-Phase Motors II	6	166
CEL-455	DC Motors III	6	167
CEL-460	Commissioning and Decommissioning Systems	12	168
CEL-465	Automated Control Systems	30	170
CEL-470	Fire Alarm Systems	12	173
CEL-475	Security and Surveillance Systems	6	176
CEL-480	Communication Systems (Voice/Data/Video and Community Antenna Television)	6	179
CEL-485	Communication Systems (Public Address and Intercom Systems)	3	181
CEL-490	Communication Systems (Nurse Call Systems)	3	185
CEL-495	Building Automation and Control Systems	12	186
CEL-500	Program Review	30	189

## **MENT-701          Mentoring II**

### **Learning Outcomes:**

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

### **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

## **CEL-405                    Grounding and Bonding Systems II**

### **Learning Outcomes:**

- Demonstrate knowledge of the methods used to service and maintain bonding and grounding and associated protection systems.

### **CEL 2015 Red Seal Occupational Standard Reference:**

11.04                    Performs servicing and maintenance of grounding and bonding systems.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Interpret codes and regulations pertaining to grounding and bonding systems.
2. Describe the methods used to service bonding and grounding and associated protection systems and their components.
3. Describe the methods used to maintain bonding and grounding and associated protection systems and their components.

#### *Practical Objectives*

N/A

## **CEL-410                    Power Conditioning, Uninterruptible Power Supply (UPS) and Surge Suppression Systems**

### **Learning Outcomes:**

- Demonstrate knowledge of types of power conditioning, UPS and surge suppression systems and their applications.
- Demonstrate knowledge of the procedures used to install power conditioning, UPS and surge suppression systems.
- Demonstrate knowledge of the procedures used to service and maintain power conditioning, UPS and surge suppression systems.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 10.01            Installs power conditioning, UPS and surge suppression systems.
- 10.02            Performs servicing and maintenance of power conditioning, UPS and surge suppression systems.

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to power conditioning, UPS and surge protection systems.
2. Explain power quality and its impact on equipment operation.
3. Explain single-phase and three-phase power factor correction and its associated calculations.
4. Identify the types of power factor correction equipment and describe their characteristics, applications and operation.
  - i) synchronous condensers (motors)
  - ii) capacitors

5. Identify equipment used to reduce harmonics in power distribution systems and describe their characteristics, applications and operation.
  - i) passive and active filters
  - ii) transformers and capacitors
6. Identify surge suppression equipment used in power distribution system conditioning and describe their characteristics, applications and operation.
  - i) capacitors
  - ii) shunt coils and diodes
7. Identify types of UPS equipment used in power distribution system conditioning and describe their characteristics, applications and operation.
  - i) online
  - ii) offline
  - iii) maintenance bypass and static bypass
  - iv) battery systems
8. Describe the procedures used to install power conditioning, UPS and surge suppression systems.
9. Identify hazards with UPS systems when working with batteries, multiple energy sources and capacitors.
10. Describe the procedures used to service and maintain power conditioning, UPS and surge suppression systems.
11. Identify electronic components and describe their application as it pertains to Power Conditioning, Uninterruptible Power Supply (UPS) and Surge Suppression Systems.

Practical Objectives:

N/A

## **CEL-415            High Voltage Equipment**

### **Learning Outcomes:**

- Demonstrate knowledge of high voltage equipment.
- Demonstrate knowledge of the procedures used to install high voltage equipment.
- Demonstrate knowledge of testing procedures for high voltage equipment.
- Demonstrate knowledge of the procedures used to service and maintain high voltage equipment.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 14.01            Installs high voltage equipment.  
14.03            Performs servicing and maintenance of high voltage systems.

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to high voltage equipment.
2. Interpret information pertaining to high voltage equipment found on drawings and specifications.
3. Identify hazards and describe safe work practices pertaining to high voltage equipment.
  - i) achieve zero-energy state
    - mechanical
    - electrical
4. Identify sources of information and documentation required by the authority having jurisdiction (AHJ) for installation of high voltage equipment.
  - i) as-builts
  - ii) schematics (AC, DC)

- iii) shop drawings
  - iv) single-line drawings
  - v) three-line 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 components and describe their characteristics and applications.
    - i) contactors
    - ii) motor starters
    - iii) transformers
    - iv) MCCs
    - v) capacitors
    - vi) reactors
    - vii) switches
    - viii) disconnects
    - ix) rectifiers
    - x) reclosers
    - xi) PTs
    - xii) CTs
    - xiii) breakers
  10. Describe the procedures used to install high voltage equipment.
  11. Describe the procedures used to install ground grid.
  12. Identify testing procedures.
  13. Identify types of acceptance tests and describe their applications.
    - i) polarization
    - ii) ground grid resistance
    - iii) high pot

- iv) phasing
  - v) functionality
  - vi) timing
  - vii) current injection
14. Describe the procedures used perform ground resistance testing and acceptance testing of high voltage equipment.
  15. Describe the procedures used to service high voltage equipment and their components.
  16. Describe the procedures used to maintain high voltage equipment and their components.

Practical Objectives:

N/A

## **CEL-420            High Voltage Cables**

### **Learning Outcomes:**

- Demonstrate knowledge of high voltage cables, their applications and operation.
- Demonstrate knowledge of the procedures used to install and terminate high voltage cables.
- Demonstrate knowledge of testing procedures for high voltage cables.
- Demonstrate knowledge of the procedures used to service and maintain high voltage cables.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 14.02            Installs high voltage cables.  
14.03            Performs servicing and maintenance of high voltage systems.

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Identify hazards and describe safe work practices pertaining to high voltage cables.
2. Interpret codes, standards and regulations pertaining to high voltage cables.
3. Interpret information pertaining to high voltage cables found on drawings and specifications.
4. Identify types of high voltage cables and describe their characteristics and applications.
  - i) armoured cables (with or without shielded conductor)
  - ii) trailing cables
  - iii) shielded cables
  - iv) unshielded cables

5. Identify high voltage cable components and describe their characteristics and applications.
  - i) potheads
  - ii) stress relief terminations
  - iii) strapping
  - iv) bracing
  - v) trays
  - vi) splice kits
  - vii) conduit
6. Identify the considerations and requirements for selecting high voltage cables and their components.
7. Describe the procedures used to install and terminate high voltage cables and their components.
8. Identify testing procedures for high voltage cables.
9. Describe the procedures used to perform high pot tests.
10. Describe the procedures used to test and service high voltage cables and their components.
11. Describe the procedures used to ground and bond high voltage cables and their components.
12. Describe the procedures used to maintain high voltage cables and their components.

Practical Objectives:

N/A

## CEL-425

## Renewable Energy and Storage Systems II

### Learning Outcomes:

- Demonstrate knowledge of renewable energy systems, their applications and operation.
- Demonstrate knowledge of the procedure to install and connect renewable energy systems and control system components.
- Demonstrate knowledge of the procedures used to service and maintain renewable energy systems.

### CEL 2015 Red Seal Occupational Standard Reference:

- 13.01            Installs renewable energy systems.  
13.02            Performs servicing and maintenance of renewable energy systems.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with renewable energy systems.
2. Interpret codes and regulations pertaining to renewable energy systems.
3. Identify types of renewable energy systems and describe their characteristics, applications and operation.
  - i) fuel cells
  - ii) wind turbines
  - iii) photovoltaic modules
  - iv) hydrokinetic
  - v) geothermal
  - vi) hydraulic turbine

4. Identify renewable energy system components and describe their characteristics, applications and operation.
5. Identify renewable energy control 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
6. Identify types of renewable energy connections.
  - i) grid dependent
  - ii) grid independent (stand-alone)
7. Describe the procedures used to install renewable energy systems and control system components.
8. Describe the procedures used to ground renewable energy systems and their components.
9. Describe the procedures used to connect renewable energy systems and control system components.
10. Describe the procedures used to service renewable energy systems and their components.
11. Describe the procedures used to maintain renewable energy systems and their components.

Practical Objectives:

N/A

## **CEL-430                    Lighting Standards**

### **Learning Outcomes:**

- Demonstrate knowledge of lighting standards and their applications.
- Demonstrate knowledge of the procedures used to remove and install lighting standards.

### **CEL 2015 Red Seal Occupational Standard Reference:**

17.04            Installs lighting standards.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes, regulations and standards pertaining to lighting standards.
2. Interpret information pertaining to lighting standards found on drawings and specifications.
3. Identify types of lighting standards and describe their applications.
  - i) traffic signal poles
  - ii) roadway lighting
  - iii) parking lot lighting
  - iv) driveway lighting
  - v) decorative aerial lighting
  - vi) decorative area lighting
  - vii) security lighting
4. Identify hazards and describe safe work practices pertaining to lighting standards.
  - i) lifting
  - ii) rigging
  - iii) environmental considerations

5. Identify lighting standard components and describe their characteristics and applications.
6. Identify the considerations and requirements for removal of lighting standards and their components.
7. Identify the considerations and requirements for selecting lighting standards and their components.
8. Describe the procedures used for rigging and hoisting lighting standards for erection and dismantling.
9. Describe the procedures used to remove lighting standards and their components.
10. Describe the procedures used to assemble, erect and secure lighting standards and their components.

Practical Objectives:

N/A

## **CEL-435            Airport Runway Lighting Systems and Controls**

### **Learning Outcomes:**

- Demonstrate knowledge of airport runway lighting systems, their components, applications and operation.
- Demonstrate knowledge of the procedures used to remove and/or install airport runway lighting systems and components.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 17.06            Installs, services and maintains airport runway lighting systems.
- 17.05            Performs servicing of branch circuitry

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret information pertaining to airport runway lighting systems found on drawings and specifications.
2. Interpret codes and regulations pertaining airport runway lighting systems.
3. Identify types of airport runway lighting systems and control components and describe their characteristics and applications.
4. Identify the considerations and requirements for removal of airport runway lighting systems and control components.
  - i) control components
    - constant current regulator
    - aircraft
5. Identify the considerations and requirements for selecting airport runway lighting systems and control components.

6. Describe the procedures used to remove airport runway lighting systems and control components.
7. Describe the procedures used to install airport runway lighting systems and control components.
8. Describe the procedures used to connect airport runway lighting systems and control components.
9. Describe the procedures used to service and maintain airport runway lighting systems and control components.
10. Describe the procedures used to test and document airport runway lighting systems and control components.

Practical Objectives:

N/A

## CEL-440                    Traffic Signal Lights and Controls

### Learning Outcomes:

- Demonstrate knowledge of types of traffic signal light systems and control components, their applications and operation.
- Demonstrate knowledge of the procedures used to remove and/or install, connect and test traffic signal light systems and control components.

### CEL 2015 Red Seal Occupational Standard Reference:

- 17.07            Installs, services and maintains traffic signal lights and controls.  
17.05            Installs servicing branch circuitry

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret information pertaining to traffic signal light systems and controls found on drawings and specifications.
2. Interpret codes and regulations pertaining to traffic signal light systems and control components.
3. Identify types of traffic signal light systems and control components and describe their characteristics and applications.
  - i) control components
    - vehicle sensors
    - cameras
    - traffic signal controllers
    - modems
4. Identify the considerations and requirements for removal of traffic signal light systems and control components.

5. Identify the considerations and requirements for selecting traffic signal light systems and control components.
6. Describe the procedures used to remove traffic signal lights and control components.
7. Describe the procedures used to install traffic signal light systems and control components.
8. Describe the procedures used to connect traffic signal light systems and control components.
9. Describe the procedures used to service and maintain traffic signal light systems and control components.
10. Describe the procedures used to test and document traffic signal light systems and control components.
11. Identify electronic components and describe their application as it pertains to Traffic Signal Lights and Controls

Practical Objectives:

N/A

## **CEL-445            Single-Phase Motors II**

### **Learning Outcomes:**

- Demonstrate knowledge of the procedures used to service and maintain single-phase motors.

### **CEL 2015 Red Seal Occupational Standard Reference:**

24.02            Performs servicing and maintenance of single-phase motors.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Describe the procedures used to diagnose, test and service single-phase motors and their components.
2. Describe the procedures used to maintain single-phase motors and their components.

#### *Practical Objectives:*

N/A

## **CEL-450            Three-Phase Motors II**

### **Learning Outcomes:**

- Demonstrate knowledge of the procedures used to service and maintain three-phase motors.

### **CEL 2015 Red Seal Occupational Standard Reference:**

24.04            Performs servicing and maintenance of three-phase motors.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1.        Describe the procedures used to diagnose, test and service three-phase motors and their components.
2.        Describe the procedures used to maintain three-phase motors and their components.

#### Practical Objectives:

N/A

## **CEL-455            DC Motors III**

### **Learning Outcomes:**

- Demonstrate knowledge of the procedures used to service and maintain DC motors.

### **CEL 2015 Red Seal Occupational Standard Reference:**

24.06            Performs servicing and maintenance of DC motors.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Describe the procedures used to diagnose, test and service DC motors and their components.
2. Describe the procedures used to maintain DC motors and their components.

#### *Practical Objectives:*

N/A

## CEL-460

## Commissioning and Decommissioning Systems

### Learning Outcomes:

- Demonstrate knowledge of startup and shutdown procedures and their purpose.
- Demonstrate knowledge of commissioning and decommissioning and their purpose.

### CEL 2015 Red Seal Occupational Standard Reference:

- 5.01 Performs startup and shutdown procedures.
- 5.02 Performs commissioning and decommissioning of systems.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives:

1. Identify hazards and describe safe work practices pertaining to starting up, shutting down, commissioning and decommissioning systems or equipment.
  - i) arc flash/blast
  - ii) moving and rotating equipment
  - iii) electric shocks
  - iv) lock-out and tag-out
2. Identify the purpose of starting up, shutting down, commissioning and decommissioning and the types of systems and equipment requiring it.
3. Identify and interpret information sources and documentation pertaining to the starting up, shutting down, commissioning and decommissioning of systems or equipment.
  - i) O&M manuals
  - ii) single line diagrams
  - iii) schematics
  - iv) panel schedules

4. Identify diagnostic and test equipment for purpose of 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

Practical Objectives:

N/A

## CEL-465            Automated Control Systems

### Learning Outcomes:

- Demonstrate knowledge of automated control systems, their applications and operation.
- Demonstrate knowledge of automated control system data highway systems.
- Demonstrate knowledge of the procedures used to install and connect automated control systems and their components.
- Demonstrate knowledge of the procedures used to service and maintain automated control systems.
- Demonstrate knowledge of the procedures for programming and configuring automated control systems.

### CEL 2015 Red Seal Occupational Standard Reference:

- 25.01            Installs automated control systems.
- 25.02            Performs servicing and maintenance of automated control systems.
- 25.03            Programs and configures automated control systems.

### Suggested Hours:

30 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to automated control systems.
2. Interpret information pertaining to automated control systems found on drawings and specifications.
3. Identify sources of information pertaining to automated control system service, maintenance, configuration and programming.
4. 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)
5. Explain and interpret control circuit logic.
- i) relay logic
  - ii) AND
  - iii) OR
  - iv) NOT
  - v) NOR
  - vi) MEMORY
  - vii) NAND
  - viii) exclusive -OR
6. Identify types of automated control systems and describe their characteristics.
- i) PLC
  - ii) SCADA
  - iii) DCS
7. 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
8. Identify types of automated control system data highway systems and describe their characteristics.
- i) Ethernet
  - ii) Modbus
  - iii) Profibus
  - iv) BACnet
  - v) Fieldbus
  - vi) DeviceNet

9. Identify automated control system data highway system components and describe their characteristics.
10. Identify the methods used to communicate with automated control systems.
  - i) handheld
  - ii) computer
  - iii) human machine interface (HMI)
11. Identify basic instruction sets for ladder logic and describe their applications.
  - i) examine if open (XIO)
  - ii) examine if closed (XIC)
  - iii) output energized (OTE)
12. Describe the procedures used to install automated control systems and their components.
13. Describe the procedures used to connect automated control systems and their components.
14. Describe the procedures used to service and maintain automated control systems and their components.
15. 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)
16. Describe the procedures used to program, edit and configure automated control systems.
  - i) online
  - ii) offline
17. Perform conversions between number systems.

Practical Objectives:

N/A

## CEL-470            Fire Alarm Systems

### Learning Outcomes:

- Demonstrate knowledge of fire alarm systems, their applications and operation.
- Demonstrate knowledge of the procedures used to install, upgrade and connect fire alarm systems.
- Demonstrate knowledge of the procedures used to service and maintain fire alarm systems.

### CEL 2015 Red Seal Occupational Standard Reference:

- 26.01            Installs fire alarm systems.
- 26.02            Performs servicing and maintenance of fire alarm systems.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to fire alarm systems.
  - i) CAN/ULC-S524
  - ii) CAN/ULC-S536
  - iii) CAN/ULC-S537
  - iv) National Building Code
  - v) National Fire Code
  - vi) Regulations specific to the AHJ
2. Interpret information pertaining to fire alarm systems found on drawings and specifications.
3. Identify types of fire alarm systems and describe their characteristics and applications.
  - i) non-addressable (Class A - Class B)
    - single stage/single zone
    - multi-zone

- two stage
  - ii) addressable (DCLA-DCLB-DCLC)
4. Describe types of associated systems that are interconnected 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
  - ix) ancillary devices (suppression system contactors and fans)
5. 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) signaling devices
    - horns
    - strobes
    - bells
  - iv) panels
    - fire alarm panels (stand-by batteries)
    - annunciator panels
  - v) relays
6. Identify the considerations and requirements for selecting fire alarm systems and their components.

7. Describe the procedures used to install, upgrade and connect fire alarm systems and their components.
8. Describe the procedures for testing fire alarm systems and their components.
9. Describe the procedures for commissioning and verification of fire alarm systems.
10. Describe the possible effect of fire alarm system service and maintenance on associated systems.
11. Describe the procedures used to service and maintain fire alarm systems and their components.

*Practical Objectives:*

N/A

## CEL-475                      Security and Surveillance Systems

### Learning Outcomes:

- Demonstrate knowledge of security and surveillance systems, their applications and operation.
- Demonstrate knowledge of the procedures used to install, upgrade and connect security and surveillance systems and their components.
- Demonstrate knowledge of the procedures used to service and maintain security and surveillance systems.

### CEL 2015 Red Seal Occupational Standard Reference:

- 26.03              Installs security and surveillance systems.  
26.04              Performs servicing and maintenance of security and surveillance systems.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to security and surveillance systems.
2. Interpret information pertaining to security and surveillance systems found on drawings and specifications.
3. Identify types of security and surveillance systems and describe their characteristics and applications.
  - i) perimeter
  - ii) space
  - iii) spot
4. Describe types of associated systems that are interconnected with security and surveillance systems.
  - i) central alarm monitoring
  - ii) automatic doors

- iii) LAN
  - iv) building automation systems
5. Identify security and surveillance system components and describe their characteristics and applications.
- i) cameras
  - ii) monitors
  - iii) DVRs
  - iv) motion sensors
  - v) card readers
  - vi) bio-scanners
  - vii) voice recognition
  - viii) electronic locks
  - ix) horns
  - x) panels
  - xi) proximity sensors
  - xii) glass break sensors
  - xiii) pressure sensors
  - xiv) RFID tags
  - xv) key pads
  - xvi) power supplies
  - xvii) servers
  - xviii) Graphic User Interface GUIs
6. Identify the considerations and requirements for selecting security and surveillance systems and their components.
7. Describe the procedures used to install, upgrade and connect security and surveillance systems and their components.
8. Describe the procedures for testing security and surveillance systems and their components.
9. Describe the procedures for the commissioning and verification of security and surveillance systems.
10. Describe the possible effects of security and surveillance system service and maintenance on associated systems.

11. Describe the procedures used to service and maintain security and surveillance systems and their components.

Practical Objectives:

N/A

## **CEL-480                    Communication Systems (Voice/Data/Video and Community Antenna Television)**

### **Learning Outcomes:**

- Demonstrate knowledge of voice/data/video (VDV) and community antenna television (CATV) systems, their applications and operation.
- Demonstrate knowledge of the procedures used to install VDV and CATV systems.
- Demonstrate knowledge of the procedures used to service and maintain VDV and CATV systems.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 27.01            Installs voice/data/video (VDV) and community antenna television (CATV) systems.
- 27.04            Performs servicing and maintenance of communication systems.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes and standards pertaining to VDV and CATV systems.
3. Describe types of associated systems that interconnect with VDV and CATV systems.
  - i) telecommunication bonding systems
  - ii) telephone systems
  - iii) data systems
  - iv) security and surveillance systems
  - v) distributed antenna system (wireless)
4. Identify VDV and CATV system components and describe their characteristics and applications.

5. Identify the considerations and requirements for selecting VDV and CATV systems and their components.
6. Describe the procedures used to install VDV and CATV systems and their components.
7. Describe the procedures for testing VDV and CATV systems and their components.
8. Describe the procedures for verification and certification of VDV and CATV systems.
9. Describe the possible effects of VDV and CATV service and maintenance on associated systems.
10. Describe the procedures used to service and maintain VDV and CATV systems and their components.

Practical Objectives:

N/A

## **CEL-485                    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 the procedures used to install, upgrade and connect PA and intercom systems.
- Demonstrate knowledge of the procedures used to service and maintain PA and intercom systems.

### **CEL 2015 Red Seal Occupational Standard Reference:**

- 27.02            Installs public address (PA) and intercom systems.  
27.04            Performs servicing and maintenance of communication systems.

### **Suggested Hours:**

3 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret codes and standards pertaining to PA and intercom systems.
2. Interpret information pertaining to PA and intercom systems found on drawings and specifications.
3. Identify types of PA and intercom systems and describe their characteristics and applications.
  - i) PA
    - perimeter
    - space
  - ii) intercom
    - one to one

4. Describe types of associated systems that interconnect with PA and intercom systems.
  - i) fire alarm systems
  - ii) audio systems
  - iii) telephone systems
  - iv) security and surveillance systems
  
5. Identify PA and intercom system components and describe their characteristics and applications.
  - i) PA
    - microphones
    - speakers
    - amplifiers
    - bells
    - power supplies
    - tone generators
    - receivers
  - ii) intercom
    - call panels
    - unit panels
    - microphones
    - speakers
    - tone generators
    - handsets
    - door release strikes
    - GUIs
    - shielded conductors
  
6. Identify the considerations and requirements for selecting PA and intercom systems and their components.
  
7. Describe the procedures used to install, upgrade and connect PA and intercom systems and their components.
  
8. Describe the procedures for testing PA and intercom systems, their components and conductors.
  
9. Describe the possible effects of PA and intercom system service and maintenance on associated systems.

10. Describe the procedures used to service and maintain PA and intercom systems and their components.

Practical Objectives:

N/A

## CEL-490                      Communication Systems (Nurse Call Systems)

### Learning Outcomes:

- Demonstrate knowledge of nurse call systems, their applications and operation.
- Demonstrate knowledge of the procedures used to install nurse call systems.
- Demonstrate knowledge of the procedures used to service and maintain nurse call systems.

### CEL 2015 Red Seal Occupational Standard Reference:

- 27.03                      Installs nurse call systems.  
27.04                      Performs servicing and maintenance of communication systems.

### Suggested Hours:

3 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and standards pertaining to nurse call systems.
2. Interpret information pertaining to nurse call systems found on drawings and specifications.
3. Identify types of nurse call systems and describe their characteristics and applications.
  - i) one-way
  - ii) two-way
  - iii) audible and visual
  - iv) direct wire
  - v) IP-based/structured cabling
4. Describe types of associated systems that interconnect with nurse call systems.
  - i) patient care LAN
  - ii) emergency power supplies
  - iii) security and surveillance

5. Identify nurse call system components and describe their characteristics and applications.
  - i) cameras
  - ii) monitors
  - iii) RFID tags
  - iv) annunciators
  - v) panels
  - vi) key pads
  - vii) GUIs
  - viii) power supplies
6. Identify the considerations and requirements for selecting nurse call systems and their components.
7. Describe the procedures used to install nurse call systems and their components.
8. Describe the procedures for testing nurse call systems and their components.
9. Describe the procedures for commissioning/verification of nurse call systems.
10. Describe the possible effects of nurse call system service and maintenance on associated systems.
11. Describe the procedures used to service and maintain nurse call systems and their components.

Practical Objectives:

N/A

## CEL-495

## Building Automation and Control Systems

### Learning Outcomes:

- Demonstrate knowledge of building automation systems, their applications and operation.
- Demonstrate knowledge of the procedures used to install building automation systems.
- Demonstrate knowledge of building control systems, their applications and operation.
- Demonstrate knowledge of the procedures used to install building automation control systems.
- Demonstrate knowledge of the procedures used to service and maintain building automation and control systems.

### CEL 2015 Red Seal Occupational Standard Reference:

- 28.01 Installs building automation systems.
- 28.02 Installs building control systems.
- 28.03 Performs servicing and maintenance of integrated control systems.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and standards pertaining to building automation and building control systems.
2. Interpret information pertaining to building automation and building control systems found on drawings and specifications.
3. Identify types of building automation systems and describe their characteristics and applications.
  - i) energy management
  - ii) security and surveillance

4. Identify building automation system components and describe their characteristics and applications.
  - i) network cabling
  - ii) sensors
    - occupancy
    - light levels
  - iii) servers
  - iv) PoE switches
  - v) GUIs
  
5. Identify types of building control systems and describe their characteristics and applications.
  - i) pneumatic
  - ii) analog electrical and direct digital control
  - iii) computer control
  
6. Identify building control system 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
  
7. Identify types of associated systems that interconnect with building automation and building control systems.
  - i) LAN
  - ii) elevator systems
  - iii) fire alarm and suppression systems
  - iv) security and surveillance systems
  - v) HVAC
  - vi) lighting

8. Identify the considerations and requirements for selecting building automation and building control systems and their components.
9. Describe the procedures used to install building automation systems and their components.
10. Describe the procedures used to install building control systems and their components.
11. Describe the procedures for testing building automation and building control systems and their components.
12. Describe the procedures for the commissioning and verification of building automation and building control systems.
13. Describe the possible effects of building automation and building control system service and maintenance on associated systems.
14. Describe the procedures used to service and maintain building automation and building control systems and their components.

Practical Objectives:

N/A

## **CEL-496                      Electric Vehicle Charging Stations**

This unit to be delivered starting September 2026/27 training year.

### **Learning Outcomes:**

- Demonstrate knowledge of electric vehicle (EV) charging stations and their operation.
- Demonstrate knowledge of electric vehicles connections.
- Demonstrate knowledge of procedures to install EV charging stations.
- Demonstrate knowledge of electric vehicle supply equipment (EVSE).

### **CEL 2021 Red Seal Occupational Standard Reference:**

Trends Section

### **Suggested Hours:**

6 Hours

### **Theoretical Objectives:**

1. Define terminology associated with EV charging stations.
2. Identify hazards and describe safe work practices pertaining to EV charging stations.
  - i) electric shock
  - ii) fire
3. Interpret codes, regulations and standards pertaining to EV charging stations.
4. Interpret information pertaining to EV charging stations found on drawings and specifications.
5. Identify types of electric vehicle supply equipment and describe their applications and operation.
  - i) Level 1
  - ii) Level 2
  - iii) DC Fast Chargers
6. Identify types of charging standards and wiring configurations.
  - i) CCS (Combined Charging System)
  - ii) CHAdeMO standard
  - iii) J-1772 standard
  - iv) NACS standard

7. Identify tools and equipment used to install EV charging stations and describe their applications and procedures for use.
8. Describe the procedures used to install and connect EV charging stations.

**Practical Objectives:**

N/A

## CEL-500                    Program Review

### Learning Outcomes:

- Demonstrate knowledge of the Red Seal Occupational Standard and its relationship to the Interprovincial Examination.
- Demonstrate knowledge of overall comprehension of the trade in preparation for the Interprovincial Examination.

### CEL 2015 Red Seal Occupational Standard Reference:

Entire Red Seal Occupational Standard (RSOS)

### Suggested Hours:

30 Hours

### Objectives and Content:

#### 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 Interprovincial Red Seal Examination.
  - 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 Interprovincial Red Seal Examination.
  - i) Red Seal website
  - ii) examination preparation guide
  - iii) sample questions
  - iv) examination counselling sheets

4. Explain the relationship between the RSOS and the AACCS.
5. Review Common Occupational Skills for the Construction Electrician trade as identified in the RSOS.
  - i) safety related functions
  - ii) organizes work
  - iii) routine trade activities
  - iv) tools and equipment
  - v) fabricates and installs support components
  - vi) commission and decommission systems
  - vii) communication and mentoring techniques
6. Review Process to install, service and maintain generating, distribution and service systems for the Construction Electrician trade as identified in the RSOS.
  - i) consumer/supply services and metering equipment
  - ii) protection devices
  - iii) distribution systems
  - iv) power conditioning, uninterruptible power supply (UPS) and surge suppression systems.
  - v) grounding, bonding and ground protection systems
  - vi) power generating systems
  - vii) renewable energy generating and storage systems
  - viii) high voltage systems
  - ix) transformers
7. Review process to install, service and maintain wiring systems for the Construction Electrician trade as identified in the RSOS.
  - i) raceways, cables, and enclosures
  - ii) branch circuitry
  - iii) heating, ventilation and air-conditioning systems
  - iv) electric heating system
  - v) exit and emergency lighting systems
  - vi) cathodic protection systems
8. Review process to install, service and maintain motor and control systems for the Construction Electrician trade as identified in the RSOS.
  - i) motor starters and controls
  - ii) drives
  - iii) automated control systems

- iv) signaling systems
- v) communication systems
- vi) integrated control systems

9. Review Canadian Electrical Code.

Practical Objectives

N/A

**Suggested Learning Activities:**

1. Conduct a mock certification exam to be used for diagnostic purposes.
2. Review the National Occupational Analysis.
3. Review the Apprentice Logbook.
4. Review the Exam Preparation information found on the homepage at [www.nsapprenticeship.ca](http://www.nsapprenticeship.ca)
5. Conduct a final mock certification exam.

**Resources:**

These are the recommended resources to use in the delivery of this unit:

- Exam Preparation information, including videos, occupational analyses, exam counseling sheets, practice exams and sample questions, and other study materials and resources, can be found on the [www.nsapprenticeship.ca](http://www.nsapprenticeship.ca) homepage under Exam Preparation.
- Apprentice's personal logbook
- Applicable codes and regulations
- Program texts

**Evaluation:** pass/fail

## Feedback and Revisions

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This AACCS will be amended periodically; comments or suggestions for improvements should be directed to:

**NB:** Apprenticeship and Occupational Certification  
 Dept. of Post-Secondary Education, Training and Labour  
 PO Box 6000, 470 York St., Rm. 110  
 Fredericton, NB E3B 5H1  
 P: 855-453-2260  
[www2.gnb.ca](http://www2.gnb.ca)

**NS:** Nova Scotia Apprenticeship Agency  
 1256 Barrington Street, 3rd Floor  
 PO Box 578  
 Halifax, NS B3J 2S9  
 P: 902-424-5651  
 Toll Free in NS: 1-800-494-5651  
[www.nsapprenticeship.ca](http://www.nsapprenticeship.ca)

**NL:** Apprenticeship and Trades Certification  
 Dept. of Advanced Education and Skills  
 PO Box 8700, Confederation Bldg. West Level, Prince Philip Dr.  
 St. John's, NL A1B 4J6  
 P: 877-771-3737  
[www.aes.gov.nl.ca/app](http://www.aes.gov.nl.ca/app)

**PE:** Apprenticeship, Training, and Certification  
 Dept. of Innovation and Advanced Learning  
 PO Box 2000  
 90 University Ave.  
 Charlottetown, PE C1A 7N8  
 P: 902-368-4460  
[www.apprenticeship.pe.ca](http://www.apprenticeship.pe.ca)

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 AACCS and will be detailed in the following section.

### Version Changes

Revision Date	Section	Description of Change
May 2024	Levels 1 and 4	Integration of MENT-700 Mentoring I and MENT-701 Mentoring II
April 2026	Level 4	Added a unit on Electric Vehicle Charging Stations for delivery in 2026/2027 training year