

# Atlantic Workforce Partnership

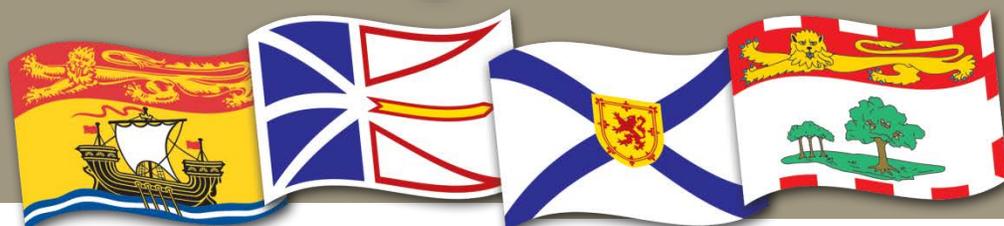
Curriculum Standard

## Industrial Electrician

Version: 2017

Revised: N/A

Atlantic Apprenticeship



# PLAN OF TRAINING

## Atlantic Apprenticeship Curriculum Standard

### Industrial Electrician

March 2017



**Government of Newfoundland and Labrador  
Department of Advanced Education, Skills and Labour  
Apprenticeship and Trades Certification Division**

Approved by:

A handwritten signature in blue ink, appearing to read "Dave H.", written over a horizontal line.

Chairperson, Provincial Apprenticeship and Certification Board

Date: March 30, 2017

## 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 Industrial Electrician program.

This document contains all the technical training elements required to complete the Industrial Electrician apprenticeship program and has been developed based on the 2016 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 Industrial 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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The Atlantic Apprenticeship Curriculum Standard (AACS) is an initiative under the Atlantic Apprenticeship Harmonization Project (AAHP) through the Atlantic Workforce Partnership and Employment and Social Development Canada.

The Atlantic apprenticeship authorities wish to acknowledge the contributions of the following industry and instructional representatives on the Atlantic Trade Advisory Committee (ATAC) who participated in the development of this document in October 2015 and November 2016

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Advisory committees, industry representatives, instructors and apprenticeship staff provided valuable input to the development of this document. Without their dedication to quality apprenticeship training, this document could not have been produced.

## 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
Level Structure .....	13
2016 RSOS to AACCS Unit Comparison.....	16
Program Content	
Level 1.....	24
Level 2.....	78
Level 3.....	120
Level 4 .....	154
Feedback and Revisions.....	201

## 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 Industrial Electrician trade.

The AACS's are 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 2016 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 journey person 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 Communication and Trade Documentation	ELE-130 Mentoring I	IEL-400 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
IEL-445 Commissioning and Decommissioning	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
IEL-415 High Voltage Equipment	IEL-420 High Voltage Cables	ELE-260 Renewable Energy & Storage Systems I	IEL-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	IEL-405 Ground Fault Detection Systems II

IEL-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	IEL-485 Automated Control Systems	ELE-380 AC Drives
ELE-385 DC Drives	ELE-355 Motor Starters II	ELE-295 DC Motors I	IEL-430 Single Phase Motors II
IEL-440 Three-Phase Motors II	IEL-435 DC Motors III		
<b>INSTALLS, SERVICES AND MAINTAINS SIGNALLING AND COMMUNICATION SYSTEMS</b>			
IEL-450 Fire Alarm Systems	IEL-455 Security and Surveillance Systems	IEL-460 Communication Systems (VDV and CATV)	IEL-465 Communication Systems (PA and Intercom Systems)
IEL-470 Communication Systems (Nurse Call Systems)	ELE-215 Introduction to Communication Systems	IEL-475 Building Automation and Control Systems	

<p style="text-align: center;">IEL-480 Predictive/Preventative Maintenance</p>	<p style="text-align: center;">IEL-495 Hydraulic Circuits and Control Systems</p>	<p style="text-align: center;">IEL-490 Pneumatic Control Systems</p>	<p style="text-align: center;">IEL-510 Environmental Control Systems</p>
<p style="text-align: center;">IEL-500 Discrete and Analog Devices</p>	<p style="text-align: center;">IEL-505 Process Control</p>		

## Level Structure

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### Level 1 - 10 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
ELE-100	Safety	6	24
ELE-105	Tools and Equipment	6	27
ELE-110	Access Equipment	6	29
ELE-115	Hoisting, Lifting and Rigging	6	31
ELE-120	Support Components	6	33
ELE-125	Communication and Trade Documentation	6	36
ELE-130	Mentoring I	6	38
ELE-135	Drawings, Schematics and Specifications I	12	40
ELE-140	Worksite Preparation and Organization	6	42
ELE-145	DC Theory	30	44
ELE-150	DC Circuits	30	46
ELE-155	Single-Phase AC Theory	18	48
ELE-160	Single-Phase AC Circuits I	30	50
ELE-165	Introduction to the Canadian Electrical Code	6	52
ELE-170	Grounding and Bonding I	6	53
ELE-175	Single Phase Services	18	55
ELE-180	Single Phase Power Distribution Equipment	18	57
ELE-185	Conductors and Cables	18	59
ELE-190	Conduit, Tubing and Fittings	12	62
ELE-195	Raceways	6	65
ELE-200	Boxes and Enclosures	12	67
ELE-205	Wiring Devices	6	69
ELE-210	Luminaires and Lighting Controls	24	71
ELE-215	Introduction to Communication Systems	6	74

## Level Structure *(continued)*

### Level 2 - 9 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
ELE-220	Job Planning	6	78
ELE-225	Voltage Drop and Power Loss	30	79
ELE-230	Environmental and Hazardous Installations	24	81
ELE-235	DC Generating Systems	12	83
ELE-240	Single-Phase AC Circuits II	27	85
ELE-245	Protection Devices	24	87
ELE-250	Extra-Low Voltage Transformers	6	90
ELE-255	Low-Voltage Single-Phase Transformers	12	92
ELE-260	Renewable Energy and Storage Systems I	9	94
ELE-265	Exit and Emergency Lighting Systems	12	96
ELE-270	Heating, Ventilation and Air-Conditioning Systems	18	98
ELE-275	Heating, Ventilation and Air-Conditioning System Controls	12	100
ELE-280	Electric Heating Systems	12	102
ELE-285	Electric Heating System Controls	12	104
ELE-290	Cathodic Protection Systems	6	106
ELE-295	DC Motors I	12	108
ELE-300	Motor Starters I	6	110
ELE-305	Motor Control Devices I	12	112
ELE-310	Drawings, Schematics and Specifications II	12	114
ELE-315	Lightning Protection Systems	6	116

### Level 3 - 8 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
ELE-320	Three-Phase Theory	30	120
ELE-325	Ground Fault Detection Systems I	12	122
ELE-330	Three-Phase Services	12	124
ELE-335	Three-Phase Power Distribution Equipment	18	126
ELE-340	AC Generating Systems	18	129
ELE-345	Low-Voltage Three-Phase Transformers	18	132
ELE-350	High Voltage Transformers	12	134
ELE-355	Motor Starters II	18	137
ELE-360	Motor Control Devices II	24	140
ELE-365	Single-Phase Motors I	18	142
ELE-370	Three-Phase Motors I	18	145
ELE-375	DC Motors II	12	147
ELE-380	AC Drives	18	149
ELE-385	DC Drives	12	151

## Level Structure (continued)

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### Level 4 - 12 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
IEL-400	Mentoring II	3	154
IEL-405	Ground Fault Detection Systems II	3	155
IEL-410	Power Conditioning, Uninterruptible Power Supply (UPS) and Surge Suppression Systems	18	156
IEL-415	High Voltage Equipment	18	158
IEL-420	High Voltage Cables	12	160
IEL-425	Renewable Energy and Storage Systems II	12	162
IEL-430	Single-Phase Motors II	6	164
IEL-435	DC Motors III	6	165
IEL-440	Three-Phase Motors II	6	166
IEL-445	Commissions and Decommissions Systems	18	167
IEL-450	Fire Alarm Systems	12	169
IEL-455	Security and Surveillance Systems	12	171
IEL-460	Communication Systems (Voice/Data/Video and Community Antenna Television)	6	173
IEL-465	Communication Systems (Public Address and Intercom Systems)	6	175
IEL-470	Communication Systems (Nurse Call Systems)	6	177
IEL-475	Building Automation and Control Systems	12	179
IEL-480	Predictive / Preventative Maintenance	12	181
IEL-485	Automated Control Systems	60	183
IEL-490	Pneumatic Control Systems	18	187
IEL-495	Hydraulic Circuits and Control Systems	12	189
IEL-500	Discrete and Analog Devices	24	191
IEL-505	Process Control	30	194
IEL-510	Environmental Control Systems	18	196
IEL-515	Program Review	30	198

## 2016 RSOS Sub-task to AACS Unit Comparison

2016 RSOS Industrial		AACS Unit	
<b>Task 1 - Performs safety-related functions.</b>			
1.01	Maintains safe work environment.	ELE-100	Safety
1.02	Uses personal protective equipment (PPE) and safety equipment	ELE-100	Safety
1.03	Performs lock-out and tag-out procedures	ELE-100	Safety
1.04	Identifies environmental conditions	ELE-230	Environmental and Hazardous Installations
<b>Task 2 - Uses and maintains 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
3.02	Identifies hazardous locations	ELE-230	Environmental and Hazardous Installations
		ELE-310	Drawings, Schematics and Specifications II
3.03	Organizes materials and supplies	ELE-140	Worksite Preparation and Organization
3.04	Plans project tasks and procedures	ELE-220	Job Planning
3.05	Prepares worksite	ELE-140	Worksite Preparation and Organization
3.06	Finalizes required documentation	ELE-125	Communication and Trade Documentation
<b>Task 4 - Performs routine trade activities.</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	Commissions systems	ELE-175	Single-Phase Services
		ELE-180	Single Phase Power Distribution Equipment
		IEL-445	Commissioning and Decommissioning

2016 RSOS Industrial		AACS Unit	
			Systems
5.02	Performs shutdown and start-up procedures	ELE-175	Single-Phase Services
		ELE-180	Single Phase Power Distribution Equipment
		IEL-445	Commissioning and Decommissioning Systems
5.03	Decommissions systems	ELE-180	Single Phase Power Distribution Equipment
		IEL-445	Commissioning and Decommissioning Systems
<b>Task 6 - Uses communication and mentoring techniques</b>			
6.01	Uses communication techniques	ELE-125	Communication and Trade Documentation
6.02	Uses mentoring techniques	ELE-130	Mentoring I
		IEL-400	Mentoring II
<b>Task 7 - consumer/supply services and metering equipment</b>			
7.01	Installs single-phase consumer/supply services and metering equipment	ELE-175	Single-Phase Services
7.02	Maintains single-phase consumer/supply services and metering equipment	ELE-175	Single-Phase Services
7.03	Installs three-phase consumer/supply services and metering equipment	ELE-330	Three-Phase Services
7.04	Maintains three-phase consumer/supply services and metering equipment	ELE-330	Three-Phase Services
<b>Task 8 - Installs and maintains protection devices</b>			
8.01	Installs overcurrent protection devices.	ELE-245	Protective Devices
8.02	Maintains overcurrent protection devices	ELE-245	Protective Devices
8.03	Installs ground fault, arc fault and surge protection devices	ELE-245	Protective Devices
8.04	Maintains ground fault, arc fault and surge protection devices	ELE-245	Protective Devices
8.05	Installs under and over voltage protection devices	ELE-245	Protective Devices
8.06	Maintains under and over voltage protection devices	ELE-245	Protective Devices
<b>Task 9 - Installs and maintains low voltage distribution systems</b>			
9.01	Installs low voltage distribution equipment	ELE-180	Single Phase Power Distribution Equipment
		ELE-330	Three Phase Power Distribution Equipment
9.02	Maintains low voltage distribution	ELE-180	Single Phase Power Distribution

2016 RSOS Industrial		AACS Unit	
	equipment.		Equipment
		ELE-335	Three Phase Power Distribution Equipment
<b>Task 10 - Installs and maintains power conditioning systems</b>			
10.01	Installs power conditioning systems	IEL-410	Power Conditioning Uninterruptible Power Supply (UPS) and Surge Suppression Systems
10.02	Maintains power conditioning systems.	IEL-410	Power Conditioning Uninterruptible Power Supply (UPS) and Surge Suppression Systems
<b>Task 11 - Installs and maintains bonding, grounding and ground fault detection systems</b>			
11.01	Installs grounding systems	ELE-170	Grounding and Bonding I
11.03	Installs bonding systems	ELE-170	Grounding and Bonding I
11.05	Installs ground fault detection systems	ELE-325	Ground Fault Detection Systems I
11.06	Maintains ground fault detection systems	IEL-405	Ground Fault Detection Systems II
<b>Task 12 - Installs and maintains power generating systems</b>			
12.01	Installs alternating current (AC) generating systems	ELE-340	AC Generating Systems
12.02	Maintains AC generating systems	ELE-340	AC Generating Systems
12.03	Installs direct current (DC) generating systems.	ELE-235	DC Generating Systems
12.04	Maintains DC generating systems.	ELE-235	DC Generating Systems
<b>Task 13 - Installs and maintains renewable energy generating and storage systems</b>			
13.01	Installs renewable energy generating and storage systems.	ELE-260	Renewable Energy and Storage Systems I
		IEL-425	Renewable Energy and Storage Systems II
13.02	Maintains renewable energy generating and storage systems	IEL-425	Renewable Energy and Storage Systems II
<b>Task 14 - Installs and maintains high voltage systems</b>			
14.01	Installs high voltage systems.	IEL-415	High Voltage Equipment
		IEL-420	High Voltage Cables
14.02	Maintains high voltage systems.	IEL-415	High Voltage Equipment
		IEL-420	High Voltage Cables
<b>Task 15 - Installs and maintains transformers</b>			
15.01	Installs extra-low voltage transformers.	ELE-250	Extra-Low Voltage Transformers
15.02	Maintains extra-low voltage transformers	ELE-250	Extra-Low Voltage Transformers
15.03	Installs low voltage single-phase transformers	ELE-255	Low-Voltage Single-Phase Transformers
15.04	Maintains low voltage single-phase	ELE-255	Low-Voltage Single-Phase

2016 RSOS Industrial		AACS Unit	
	transformers		Transformers
15.05	Installs low voltage three-phase transformers	ELE-345	Low-Voltage Three-Phase Transformers
15.06	Maintains low voltage three-phase transformers	ELE-345	Low-Voltage Three-Phase Transformers
15.07	Installs high voltage transformers	ELE-350	High Voltage Transformers
15.08	Maintains high voltage transformers	ELE-350	High Voltage Transformers
<b>Task 16 - Installs and maintains raceways, cables, conductors and enclosures</b>			
16.01	Installs conductors and cables	ELE-185	Conductors and Cables
16.02	Maintains conductors and cables	ELE-185	Conductors and Cables
16.03	Installs conduit, tubing and fittings	ELE-190	Conduit, Tubing and Fittings
16.04	Installs raceways	ELE-195	Raceways
16.05	Installs boxes and enclosures	ELE-200	Boxes and Enclosures
16.06	Maintains conduit, tubing, fittings, raceways, boxes and enclosures	ELE-190	Conduit, Tubing and Fittings
		ELE-195	Raceways
		ELE-200	Boxes and Enclosures
		ELE-230	Environmental and Hazardous Installations
<b>Task 17 - Installs and maintains branch circuitry and devices</b>			
17.01	Installs luminaires	ELE-210	Luminaires, and Lighting Controls
17.02	Maintains luminaires	ELE-210	Luminaires, and Lighting Controls
17.03	Installs wiring devices	ELE-205	Wiring Devices
17.04	Maintains wiring devices	ELE-205	Wiring Devices
<b>Task 18 - Installs and maintains heating, ventilation and air-conditioning (HVAC) electrical components</b>			
18.01	Connects power to HVAC systems and associated equipment.	ELE-270	Heating, Ventilation and Air-Conditioning Systems
18.02	Installs HVAC controls	ELE-275	Heating, Ventilation and Air-Conditioning System Controls
18.03	Maintains HVAC electrical components	ELE-275	Heating, Ventilation and Air-Conditioning System Controls
<b>Task 19 - Installs and maintains electric heating systems and controls</b>			
19.01	Installs electric heating systems and controls.	ELE-280	Electric Heating Systems
		ELE-285	Electric Heating Systems Controls
19.02	Maintains electric heating systems and controls	ELE-280	Electric Heating Systems
		ELE-285	Electric Heating System Controls
<b>Task 20 - Installs and maintains exit and emergency lighting systems</b>			
20.01	Installs exit and emergency lighting systems.	ELE-265	Exit and Emergency Lighting Systems
20.02	Maintains exit and emergency lighting systems.	ELE-265	Exit and Emergency Lighting Systems
<b>Task 21 - Installs and maintains cathodic protection systems</b>			

2016 RSOS Industrial		AACS Unit	
21.01	Installs cathodic protection systems	ELE-290	Cathodic Protection Systems
21.02	Maintains cathodic protection systems	ELE-290	Cathodic Protection Systems
<b>Task 22 - Installs and maintains motor starters and control devices.</b>			
22.01	Installs motor starters	ELE-300	Motor Starters I
		ELE-355	Motor Starters II
22.02	Maintains motor starters	ELE-300	Motor Starters I
		ELE-355	Motor Starters II
22.03	Installs motor control devices.	ELE-305	Motor Control Devices I
		ELE-360	Motor Control Devices II
22.04	Maintains motor control devices	ELE-305	Motor Controls Devices I
		ELE-360	Motor Controls Devices II
<b>Task 23 - Installs and maintains drives.</b>			
23.01	Installs AC drives	ELE-380	AC Drives
23.02	Maintains AC drives.	ELE-380	AC Drives
23.03	Installs DC drives	ELE-385	DC Drives
23.04	Maintains DC drives	ELE-385	DC Drives
<b>Task 24 - Installs and maintains non-rotating equipment and associated controls</b>			
24.01	Installs non-rotating equipment and associated controls.	IEL-510	Environmental Control Systems
24.02	Maintains non-rotating equipment and associated controls	IEL-510	Environmental Control Systems
<b>Task 25 - Installs and maintains motors.</b>			
25.01	Installs single-phase motors	ELE-365	Single-Phase Motors I
25.02	Maintains single-phase motors	IEL-430	Single Phase Motors II
25.03	Installs three-phase motors	ELE-370	Three-Phase Motors I
25.04	Maintains three-phase motors	IEL-440	Three Phase Motors II
25.05	Installs DC motors	ELE-295	DC Motors I
		ELE-375	DC Motors II
25.06	Maintains DC motors.	IEL-435	DC Motors III
<b>Task 26 - Installs and maintains signalling systems.</b>			
26.01	Installs fire alarm systems.	IEL-450	Fire Alarm Systems
26.02	Maintains fire alarm systems.	IEL-450	Fire Alarm Systems
26.03	Installs security and surveillance systems.	IEL-455	Security and Surveillance Systems
26.04	Maintains security and surveillance systems	IEL-455	Security and Surveillance Systems
<b>Task 27 - Installs and maintains communication systems</b>			
27.01	Installs communication systems.	ELE-215	Introduction to Communication Systems
		IEL-460	Communication Systems

2016 RSOS Industrial		AACS Unit	
			(Voice/Data/Video and Community Antenna TV)
		IEL-465	Communication Systems (Public Address and Intercom Systems)
		IEL-470	Communication Systems (Nurse Call Systems)
27.02	Maintains communication systems.	IEL-460	Communication Systems (Voice/Data/Video and Community Antenna TV)
		IEL-465	Communication Systems (Public Address and Intercom Systems)
		IEL-470	Communication Systems (Nurse Call Systems)
<b>Task 28 - Installs and maintains building automation systems</b>			
28.01	Installs building automation systems	IEL-475	Building Automation and Control Systems
28.02	Maintains building automation systems	IEL-475	Building Automation and Control Systems
<b>Task 29 - Installs and maintains input/output (I/O) devices</b>			
29.01	Installs discrete input/output (I/O) devices	IEL-500	Discrete and Analog Devices
29.02	Maintains discrete input/output (I/O) devices	IEL-500	Discrete and Analog Devices
29.03	Installs analog input/output (I/O) devices	IEL-500	Discrete and Analog Devices
29.04	Maintains analog input/output (I/O) devices	IEL-500	Discrete and Analog Devices
<b>Task 30 - Installs and maintains input/output (I/O) devices</b>			
30.01	Installs automated control systems	IEL-485	Automated Control Systems
30.02	Maintains automated control systems	IEL-485	Automated Control Systems
		IEL-505	Process Control
30.03	Programs automated control systems	IEL-485	Automated Control Systems
30.04	Optimizes system performance	IEL-485	Automated Control Systems
		IEL-505	Process Control
<b>Task 31 - Installs and maintains pneumatic and hydraulic control systems</b>			
31.01	Installs pneumatic control systems	IEL-490	Pneumatic Control Systems
31.02	Maintains pneumatic control systems	IEL-490	Pneumatic Control Systems
31.03	Installs hydraulic control systems	IEL-495	Hydraulic Circuits and Controls Systems
31.04	Maintains hydraulic control systems	IEL-495	Hydraulic Circuits and Control Systems



# Level 1

<b>Unit Code</b>	<b>Unit Title</b>	<b>Hours</b>	<b>Page</b>
ELE-100	Safety	6	24
ELE-105	Tools and Equipment	6	27
ELE-110	Access Equipment	6	29
ELE-115	Hoisting, Lifting and Rigging	6	31
ELE-120	Support Components	6	33
ELE-125	Communication and Trade Documentation	6	36
ELE-130	Mentoring I	6	38
ELE-135	Drawings, Schematics and Specifications I	12	40
ELE-140	Worksite Preparation and Organization	6	42
ELE-145	DC Theory	30	44
ELE-150	DC Circuits	30	46
ELE-155	Single-Phase AC Theory	18	48
ELE-160	Single-Phase AC Circuits I	30	50
ELE-165	Introduction to the Canadian Electrical Code	6	52
ELE-170	Grounding and Bonding I	6	53
ELE-175	Single Phase Services	18	55
ELE-180	Single Phase Power Distribution Equipment	18	57
ELE-185	Conductors and Cables	18	59
ELE-190	Conduit, Tubing and Fittings	12	62
ELE-195	Raceways	6	65
ELE-200	Boxes and Enclosures	12	67
ELE-205	Wiring Devices	6	69
ELE-210	Luminaires and Lighting Controls	24	71
ELE-215	Introduction to Communication Systems	6	74

## 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.

### 2016 Red Seal Occupational Standard Reference:

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

### 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.

### **2016 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.

### **2016 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.

### **2016 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.

### 2016 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

## Communication and Trade Documentation

### Learning Outcomes:

- Demonstrate knowledge of trade terminology.
- Demonstrate knowledge of effective communication practices.
- Demonstrate knowledge of documentation its purpose, application and use.

### 2016 Red Seal Occupational Standard Reference:

3.06 Finalizes required documentation.

6.01 Uses communication techniques.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology used in the trade.
2. Describe the importance of using effective verbal and non-verbal communication with people in the workplace.
  - i) other tradespeople
  - ii) colleagues
  - iii) apprentices
  - iv) supervisors
  - v) clients
  - vi) authority having jurisdiction (AHJ)
  - vii) manufacturers
3. Identify sources of information to effectively communicate.
  - 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
4. Identify communication and learning styles.
- i) learning styles
    - seeing it
    - hearing it
    - trying it
5. Identify personal responsibilities and attitudes that contribute to on-the-job success.
- i) asking questions
  - ii) working safely
  - iii) accepting constructive feedback
  - iv) time management and punctuality
  - v) respect for authority
  - vi) good stewardship of materials, tools and property
  - vii) effective work practice
6. Identify communication that constitutes harassment and discrimination.
7. Describe and identify types of documentation developed from different tasks.
8. Describe the procedures for finalizing documentation.

Practical Objectives:

N/A

## **ELE-130                    Mentoring I**

### **Learning Outcomes:**

- Demonstrate knowledge of strategies for learning skills in the workplace.

### **2016 Red Seal Occupational Standard Reference:**

6.02 Uses mentoring techniques.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Describe the importance of individual experience.
2. Describe the shared responsibilities for workplace learning.
3. Determine one's own learning preferences and explain how these relate to learning new skills.
4. Describe the importance of different types of skills in the workplace.
5. Describe the importance of essential skills in the workplace.
  - i) reading
  - ii) writing
  - iii) document use
  - iv) oral communication
  - v) numeracy
  - vi) thinking skills
  - vii) working with others
  - viii) digital technology
  - ix) continuous learning

6. Identify different learning needs and describe the strategies to meet these needs.
  - i) learning disabilities
  - ii) learning preferences
  - iii) language proficiency
  
7. Identify strategies to assist in learning a skill.
  - i) understanding basic principles of instruction
  - ii) developing coaching skills
  - iii) being mature and patient
  - iv) providing feedback

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.

### 2016 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.

### 2016 Red Seal Occupational Standard Reference:

- 3.03 Organizes materials and supplies.
- 3.05 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.

### 2016 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.

### 2016 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 Kirchhoff'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.

### **2016 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.
  - 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.

### 2016 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).

### 2016 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.

### **2016 Red Seal Occupational Standard Reference:**

- 11.01 Installs grounding systems.
- 11.03 Installs 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 single-phase services.
- 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.

### **2016 Red Seal Occupational Standard Reference:**

- 5.01 Commissions systems.
- 5.02 Performs shutdown and start-up procedures.
- 7.01 Installs single-phase consumer/supply services and metering equipment.
- 7.02 Maintains single-phase consumer/supply services and metering equipment.

### **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.

### 2016 Red Seal Occupational Standard Reference:

- 5.01 Commissions systems.
- 5.02 Performs shutdown and startup procedures.
- 5.03 Decommissions systems.
- 9.01 Installs low voltage distribution equipment.
- 9.02 Maintains low voltage distribution equipment.

### 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/ampere 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.

### **2016 Red Seal Occupational Standard Reference:**

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

### **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) odors
    - viii) colours

- 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.

### **2016 Red Seal Occupational Standard Reference:**

16.03 Installs conduit, tubing and fittings.

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

### **Suggested Hours:**

12 Hours

### **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.
  - i) EMT
  - ii) Rigid PVC
  - iii) Flexible conduit
  - iv) Rigid steel
  - v) ENT

- vi) 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.
  - i) 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.

### **2016 Red Seal Occupational Standard Reference:**

16.04 Installs raceways.

16.06 Maintains conduit, tubing, fittings, raceways, boxes 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.

### **2016 Red Seal Occupational Standard Reference:**

16.05 Installs boxes and enclosures.

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

### **Suggested Hours:**

12 Hours

### **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.
  - i) device
  - ii) utility
  - iii) FS/FD
  - iv) masonry
  - v) square
  - vi) octagon
  - vii) pancake
  - viii) power and communication

- ix) 347 V
  - x) pull
  - xi) splitter
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.

### 2016 Red Seal Occupational Standard Reference:

- 17.03 Installs wiring devices.  
17.04 Maintains wiring devices.

### 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
  - iii) sensors
  - iv) safety switches
  - v) power outlets
  - vi) 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.

### 2016 Red Seal Occupational Standard Reference:

17.01 Installs luminaires.

17.02 Maintains luminaires.

### 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 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 lightning 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.

### **2016 Red Seal Occupational Standard Reference:**

27.01 Installs communication 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.
- i) Shielding

Practical Objectives

N/A



# Level 2

Unit Code	Unit Title	Hours	Page
ELE-220	Job Planning	6	78
ELE-225	Voltage Drop and Power Loss	30	79
ELE-230	Environmental and Hazardous Installations	24	81
ELE-235	DC Generating Systems	12	83
ELE-240	Single-Phase AC Circuits II	27	85
ELE-245	Protection Devices	24	87
ELE-250	Extra-Low Voltage Transformers	6	90
ELE-255	Low-Voltage Single-Phase Transformers	12	92
ELE-260	Renewable Energy and Storage Systems I	9	94
ELE-265	Exit and Emergency Lighting Systems	12	96
ELE-270	Heating, Ventilation and Air-Conditioning Systems	18	98
ELE-275	Heating, Ventilation and Air-Conditioning System Controls	12	100
ELE-280	Electric Heating Systems	12	102
ELE-285	Electric Heating System Controls	12	104
ELE-290	Cathodic Protection Systems	6	106
ELE-295	DC Motors I	12	108
ELE-300	Motor Starters I	6	110
ELE-305	Motor Controls Devices I	12	112
ELE-310	Drawings, Schematics and Specifications II	12	114
ELE-315	Lightning Protection Systems	6	116

## ELE-220            Job Planning

### Learning Outcomes:

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

### 2016 Red Seal Occupational Standard Reference:

3.04 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.

### **2016 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.

### 2016 Red Seal Occupational Standard Reference:

- 1.04 Identifies environmental conditions.
- 3.02 Identifies hazardous locations.
- 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

**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.

**2016 Red Seal Occupational Standard Reference:**

12.03 Installs direct current (DC) generating systems.

12.04 Maintains 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
  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.

### 2016 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.

### 2016 Red Seal Occupational Standard Reference:

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

### 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.

### 2016 Red Seal Occupational Standard Reference:

15.01 Installs extra-low voltage transformers.

15.02 Maintains extra-low voltage 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.

### 2016 Red Seal Occupational Standard Reference:

15.03 Installs low voltage single-phase transformers.

15.04 Maintains low voltage single-phase transformers.

### Suggested Hours:

12 Hours

### 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.

### 2016 Red Seal Occupational Standard Reference:

13.01 Installs renewable energy generating and storage 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.

### 2016 Red Seal Occupational Standard Reference:

20.01 Installs exit and emergency lighting systems.

20.02 Maintains exit and emergency lighting systems.

### Suggested Hours:

12 Hours

### 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.

### 2016 Red Seal Occupational Standard Reference:

18.01 Connects power to HVAC systems and associated equipment.

### 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
  - vi) 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.

### **2016 Red Seal Occupational Standard Reference:**

18.02 Installs HVAC controls.

18.03 Maintains HVAC electrical components.

### **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.

### **2016 Red Seal Occupational Standard Reference:**

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

### **Suggested Hours:**

12 Hours

### **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
  - ix) hot water heater
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.

### 2016 Red Seal Occupational Standard Reference:

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

### Suggested Hours:

12 Hours

### 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.

### 2016 Red Seal Occupational Standard Reference:

21.01 Installs cathodic protection systems.

21.02 Maintains 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.

### 2016 Red Seal Occupational Standard Reference:

25.05 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.

### **2016 Red Seal Occupational Standard Reference:**

- 22.01 Installs motor starters.
- 22.02 Maintains 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.

### **2016 Red Seal Occupational Standard Reference:**

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

### **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.

### 2016 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.

### **2016 Red Seal Occupational Standard Reference:**

N/A

### **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)
    - off-grid
    - 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

Unit Code	Unit Title	Hours	Page
ELE-320	Three-Phase Theory	30	120
ELE-325	Ground Fault Detection Systems I	12	122
ELE-330	Three-Phase Services	12	124
ELE-335	Three-Phase Distribution Equipment	18	126
ELE-340	AC Generating Systems	18	129
ELE-345	Low-Voltage Three-Phase Transformers	18	132
ELE-350	High Voltage Transformers	12	134
ELE-355	Motor Starters II	18	137
ELE-360	Motor Control Devices II	24	140
ELE-365	Single-Phase Motors I	18	142
ELE-370	Three-Phase Motors I	18	145
ELE-375	DC Motors II	12	147
ELE-380	AC Drives	18	149
ELE-385	DC Drives	12	151

## **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.

### **2016 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.

### 2016 Red Seal Occupational Standard Reference:

11.05 Installs ground fault detection 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 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.

### **2016 Red Seal Occupational Standard Reference:**

- 7.03 Installs three-phase consumer/supply services and metering equipment.  
7.04 Maintains three-phase consumer/supply 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.

### 2016 Red Seal Occupational Standard Reference:

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

### 2016 Red Seal Occupational Standard Reference:

12.01 Installs alternating current (AC) generating systems.

12.02 Maintains 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.
    - i) transfer switch
    - ii) prime mover
    - iii) cables
    - iv) conductors
    - v) overcurrent devices
    - vi) overload devices
    - vii) fuel monitoring and storage devices
  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.

### 2016 Red Seal Occupational Standard Reference:

15.05 Installs low voltage three-phase transformers.

15.06 Maintains low voltage three-phase transformers.

### Suggested Hours:

18 Hours

### 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.

### **2016 Red Seal Occupational Standard Reference:**

15.07 Installs high voltage transformers.

15.08 Maintains high voltage 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.

### **2016 Red Seal Occupational Standard Reference:**

- 22.01 Installs motor starters.
- 22.02 Maintains motor starters.

### **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.

### 2016 Red Seal Occupational Standard Reference:

22.03 Installs motor control devices.

22.04 Maintains motor control devices.

### 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.

### 2016 Red Seal Occupational Standard Reference:

25.01 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.

### **2016 Red Seal Occupational Standard Reference:**

25.03 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.

### 2016 Red Seal Occupational Standard Reference:

25.05 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.

### **2016 Red Seal Occupational Standard Reference:**

- 23.01 Installs AC drives.
- 23.02 Maintains 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.

### **2016 Red Seal Occupational Standard Reference:**

- 23.03 Installs DC drives.  
23.04 Maintains 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	Hours	Page
IEL-400	Mentoring II	3	154
IEL-405	Ground Fault Detection Systems II	3	155
IEL-410	Power Conditioning, Uninterruptible Power Supply (UPS) and Surge Suppression Systems	18	156
IEL-415	High Voltage Equipment	18	158
IEL-420	High Voltage Cables	12	160
IEL-425	Renewable Energy and Storage Systems II	12	162
IEL-430	Single-Phase Motors II	6	164
IEL-435	DC Motors III	6	165
IEL-440	Three-Phase Motors II	6	166
IEL-445	Commissions and Decommissions Systems	18	167
IEL-450	Fire Alarm Systems	12	169
IEL-455	Security and Surveillance Systems	12	171
IEL-460	Communication Systems (Voice/Data/Video and Community Antenna Television)	6	173
IEL-465	Communication Systems (Public Address and Intercom Systems)	6	175
IEL-470	Communication Systems (Nurse Call Systems)	6	177
IEL-475	Building Automation and Control Systems	12	179
IEL-480	Predictive / Preventative Maintenance	12	181
IEL-485	Automated Control Systems	60	183
IEL-490	Pneumatic Control Systems	18	187
IEL-495	Hydraulic Circuits and Control Systems	12	189
IEL-500	Discrete and Analog Devices	24	191
IEL-505	Process Control	30	194
IEL-510	Environmental Control Systems	18	196
IEL-515	Program Review	30	198

## **IEL-400                      Mentoring II**

### **Learning Outcomes:**

- Demonstrate knowledge of strategies for teaching workplace skills.

### **2016 Red Seal Occupational Standard Reference:**

6.02 Uses mentoring techniques.

### **Suggested hours:**

3 Hours

### **Objectives and Content:**

#### Theoretical Objectives:

1. Identify different roles played by a workplace mentor.
2. Identify how to choose a good time to present a lesson.
3. Explain the importance of linking the lesson.
4. Identify the component of the skill (the context).
5. Describe considerations in setting up opportunities for skill practice.
6. Explain the importance of giving feedback.
7. Identify techniques for giving effective feedback.
8. Describe a skills assessment.
9. Identify methods of assessing progress.
10. Explain how to adjust a lesson to different situations.

#### Practical Objectives:

N/A

**IEL-405**

## **Ground Fault Detection Systems II**

### **Learning Outcomes:**

- Demonstrate knowledge of the methods used to maintain ground fault detection systems.

### **2016 Red Seal Occupational Standard Reference:**

11.06 Maintains ground fault detection systems.

### **Suggested Hours:**

3 Hours

### **Objectives and Content:**

#### *Theoretical Objectives:*

1. Describe the methods used to maintain ground fault detection systems and their components according to manufacturers' specifications.

#### *Practical Objectives*

N/A

## **IEL-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 procedures used to install power conditioning, UPS and surge suppression systems.
- Demonstrate knowledge of the methods and theory used to maintain power conditioning systems.

### **2016 Red Seal Occupational Standard Reference:**

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

### **Suggested Hours:**

18 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, UPS and surge suppression systems.

Practical Objectives

N/A

## IEL-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.

### 2016 Red Seal Occupational Standard Reference:

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

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with high voltage breakers and starters.
2. Identify hazards and describe safe work practices pertaining to high voltage breakers and starters.
  - i) achieve zero energy state
    - mechanical
    - electrical
3. Interpret codes and regulations pertaining to high voltage breakers and starters.
4. Interpret information pertaining to high voltage breakers and starters found on drawings and specifications.
5. Identify tools and equipment relating to high voltage breakers and starters and describe their applications and procedures for use.

6. Identify types of high voltage breakers and describe their characteristics and applications.
  - i) air
  - ii) oil
  - iii) air blast
  - iv) vacuum
  - v) gas
7. Identify high voltage breaker components and accessories and describe their characteristics and applications.
8. Identify types of high voltage starters and describe their characteristics and applications.
9. Identify high voltage starter components and accessories and describe their characteristics and applications.
10. Identify the considerations and requirements for selecting high voltage breakers and starters, their components and accessories.
11. Describe the procedures used to install and connect high voltage breakers and starters, their components and accessories.
12. Describe the procedures used to isolate and troubleshoot high voltage breakers and starters, their components and accessories.
13. Describe the procedures used for temporary grounding of high voltage equipment.
14. Describe the procedures used to maintain, repair and test high voltage breakers and starters, their components and accessories.
15. Describe the procedures to commission, startup, shutdown, and decommission high voltage equipment.

Practical Objectives

N/A

## IEL-420                      High Voltage Cables

### Learning Outcomes:

- Demonstrate knowledge of high voltage cables, their applications and operation.
- Demonstrate knowledge of the procedures used to install, splice and terminate high voltage wiring.
- Demonstrate knowledge of the procedures used to test and maintain high voltage cables.
- Demonstrate knowledge of methods used to install and remove temporary protective grounds.

### 2016 Red Seal Occupational Standard Reference:

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

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with high voltage wiring.
2. Identify hazards and describe safe work practices pertaining to high voltage wiring.
3. Identify grounding and bonding requirements relating to high voltage wiring.
4. Interpret codes and regulations pertaining to high voltage wiring.
5. Interpret information pertaining to high voltage wiring found on drawings and specifications.
6. Identify tools and equipment relating to high voltage wiring and describe their applications and procedures for use.

7. Identify types of high voltage cables and describe their characteristics and applications.
  - i) concentric neutral
  - ii) non-shielded
  - iii) shielded
8. Identify high voltage cable components and accessories and describe their characteristics and applications.
9. Identify the considerations and requirements for selecting high voltage cables, their components and accessories.
10. Describe the procedures used to install high voltage cables, their components and accessories.
11. Describe the procedures used to terminate, splice and test high voltage cables.
12. Describe the procedures used for temporary grounding of high voltage equipment.

Practical Objectives

N/A

## IEL-425

## Renewable Energy and Storage Systems II

### Learning Outcomes:

- Demonstrate knowledge of alternative power systems, their applications and operation.
- Demonstrate knowledge of the procedure to install, connect, troubleshoot, repair and test alternative power systems.

### 2016 Red Seal Occupational Standard Reference:

13.01 Installs renewable energy generating and storage systems.

13.02 Maintains renewable energy generating and storage 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
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.
12. Identify electronic components and describe their application as it pertains to Renewable Energy and Storage Systems.
13. Describe the procedures to commission, startup, shutdown, and decommission Renewable Energy and Storage Systems.

Practical Objectives

N/A

**IEL-430**

## **Single-Phase Motors II**

### **Learning Outcomes:**

- Demonstrate knowledge of *single-phase motors*, their applications and operation.
- Demonstrate knowledge of procedures used to maintain *single-phase motors*

### **2016 Red Seal Occupational Standard Reference:**

25.02 Maintains 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

**IEL-435**

**DC Motors III**

**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.

**2016 Red Seal Occupational Standard Reference:**

25.06 Maintains DC motors.

**Suggested Hours:**

6 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 diagnose and test DC motors and their components.
5. Describe the procedures used to maintain DC motors and their components.

Practical Objectives:

N/A

## **IEL-440                    Three-Phase Motors II**

### **Learning Outcomes:**

- Demonstrate knowledge of procedures used to maintain three-phase motors

### **2016 Red Seal Occupational Standard Reference:**

25.04 Maintains 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.
  - i)        25 hp and up.
  
2.        Describe the procedures used to maintain three-phase motors and their components.
  - i)        25 hp and up.

#### Practical Objectives

N/A

## IEL-445

## Commissions and Decommissions Systems

### Learning Outcomes:

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

### 2016 Red Seal Occupational Standard Reference:

- 5.01 Commissions systems.
- 5.02 Performs shutdown and startup procedures.
- 5.03 Decommissions systems.

### Suggested Hours:

18 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

## **IEL-450                      Fire Alarm Systems**

### **Learning Outcomes:**

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

### **2016 Red Seal Occupational Standard Reference:**

26.01 Installs fire alarm systems.

26.02 Maintains fire alarm systems.

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Define terminology associated with fire alarm systems.
2. Identify hazards and describe safe work practices pertaining to fire alarm systems.
3. Interpret codes and regulations pertaining to fire alarm systems.
  - i) Canadian Electrical Code requirements
  - ii) National Building Code requirements
  - iii) Fire Code requirements
4. Interpret information pertaining to fire alarm systems found on drawings and specifications.
5. Identify tools and equipment relating to fire alarm systems and describe their applications and procedures for use.
6. Identify types of fire alarm systems and describe their characteristics and applications.

- i) single stage/single zone
  - ii) multi-zone
  - iii) two stage
  - iv) addressable
7. Identify fire alarm system components and accessories and describe their characteristics and applications.
- i) initiating devices
  - ii) signaling devices
  - iii) control panel
  - iv) ancillary device
8. Identify the considerations and requirements for selecting fire alarm systems, their components and accessories.
9. Describe the procedures used to install and connect fire alarm systems, their components and accessories.
10. Describe the procedures used to troubleshoot fire alarm systems, their components and accessories.
11. Describe the procedures used to maintain, repair and test fire alarm systems, their components and accessories.
12. Identify electronic components and describe their application as it pertains to fire alarm systems.
13. Describe the procedures to commission, startup, shutdown, and decommission fire alarm systems.

Practical Objectives

N/A

## IEL-455                      Security and Surveillance Systems

### Learning Outcomes:

- Demonstrate knowledge of security systems, their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot, maintain, repair and test security systems.

### 2016 Red Seal Occupational Standard Reference:

- 26.03 Installs security and surveillance systems.  
26.04 Maintains security and surveillance systems.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives:

1. Define terminology associated with security systems.
2. Identify hazards and describe safe work practices pertaining to security systems.
3. Interpret codes and regulations pertaining to security systems.
4. Interpret information pertaining to security systems found on drawings and specifications.
5. Identify tools and equipment relating to security systems and describe their applications and procedures for use.
6. Identify types of security and surveillance systems and describe their characteristics and applications.
  - i) perimeter
  - ii) space
  - iii) spot

7. Identify security and surveillance system components and accessories and describe their characteristics and applications.
  - i) devices
    - detection/monitoring
    - alarm/signaling
    - access
  - ii) control panels
8. Identify the considerations and requirements for selecting security and surveillance systems, their components and accessories.
9. Describe the procedures used to install and connect security and surveillance systems, their components and accessories.
10. Describe the procedures used to troubleshoot security and surveillance systems, their components and accessories.
11. Describe the procedures used to maintain, repair and test security and surveillance systems, their components and accessories.
12. Identify electronic components and describe their application as it pertains to security and surveillance systems.
13. Describe the procedures to commission, startup, shutdown, and decommission security and surveillance systems.

Practical Objectives

N/A

**IEL-460                      Communication Systems (Voice/Data/Video and  
Community Antenna TV)**

**Learning Outcomes:**

- Demonstrate knowledge of communication systems, their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot, maintain, repair and test communication systems.

**2016 Red Seal Occupational Standard Reference:**

- 27.01 Installs communication systems.
- 27.02 Maintains communication systems.

**Suggested Hours:**

6 Hours

**Objectives and Content:**

Theoretical Objectives

1. Define terminology associated with communication systems.
2. Identify hazards and describe safe work practices pertaining to communication systems.
3. Interpret codes and regulations pertaining to communication systems.
4. Interpret information pertaining to communication systems found on drawings and specifications.
5. Identify tools and equipment relating to communication systems and describe their applications and procedures for use.
6. Identify types of communication systems and describe their characteristics and applications.
  - i) voice/data

- ii) public address
  - iii) nurse call
7. Identify communication system components and accessories and describe their characteristics and applications.
  8. Identify methods of data transfer and describe their applications.
    - i) copper
    - ii) fiber optic
    - iii) wireless
  9. Identify the considerations and requirements for selecting communication systems, their components and accessories.
  10. Describe the procedures used to install and connect communication systems, their components and accessories.
  11. Describe the procedures used to troubleshoot communication systems, their components and accessories.
  12. Describe the procedures used to maintain, repair and test communication systems, their components and accessories.

Practical Objectives

N/A

## **IEL-465                      Communication Systems (Public Address and Intercom Systems)**

### **Learning Outcomes:**

- Demonstrate knowledge of communication systems, their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot, maintain, repair and test communication systems.

### **2016 Red Seal Occupational Standard Reference:**

- 27.01 Installs communication systems.
- 27.02 Maintains communication systems.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Define terminology associated with communication systems.
2. Identify hazards and describe safe work practices pertaining to communication systems.
3. Interpret codes and regulations pertaining to communication systems.
4. Interpret information pertaining to communication systems found on drawings and specifications.
5. Identify tools and equipment relating to communication systems and describe their applications and procedures for use.
6. Identify types of communication systems and describe their characteristics and applications.
  - i) voice/data

- ii) public address
  - iii) nurse call
  - iv) building automation
7. Identify communication system components and accessories and describe their characteristics and applications.
  8. Identify methods of data transfer and describe their applications.
    - i) copper
    - ii) fiber optic
    - iii) wireless
  9. Identify the considerations and requirements for selecting communication systems, their components and accessories.
  10. Describe the procedures used to install and connect communication systems, their components and accessories.
  11. Describe the procedures used to troubleshoot communication systems, their components and accessories.
  12. Describe the procedures used to maintain, repair and test communication systems, their components and accessories.

Practical Objectives

N/A

## IEL-470                      Communication Systems (Nurse Call Systems)

### Learning Outcomes:

- Demonstrate knowledge of communication systems, their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot, maintain, repair and test communication systems.

### 2016 Red Seal Occupational Standard Reference:

- 27.01 Installs communication systems.
- 27.02 Maintains communication systems.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with communication systems.
2. Identify hazards and describe safe work practices pertaining to communication systems.
3. Interpret codes and regulations pertaining to communication systems.
4. Interpret information pertaining to communication systems found on drawings and specifications.
5. Identify tools and equipment relating to communication systems and describe their applications and procedures for use.
6. Identify types of communication systems and describe their characteristics and applications.
  - i) voice/data
  - ii) public address

- iii) nurse call
  - iv) building automation
7. Identify communication system components and accessories and describe their characteristics and applications.
  8. Identify methods of data transfer and describe their applications.
    - i) copper
    - ii) fiber optic
    - iii) wireless
  9. Identify the considerations and requirements for selecting communication systems, their components and accessories.
  10. Describe the procedures used to install and connect communication systems, their components and accessories.
  11. Describe the procedures used to troubleshoot communication systems, their components and accessories.
  12. Describe the procedures used to maintain, repair and test communication systems, their components and accessories.

Practical Objectives

N/A

## IEL-475                      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, connect, calibrate, troubleshoot, maintain, repair and test building automation systems.

### 2016 Red Seal Occupational Standard Reference:

28.01 Installs building automation systems.

28.02 Maintains building automation systems.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with building automation systems.
2. Identify hazards and describe safe work practices pertaining to building automation systems.
3. Interpret codes and regulations pertaining to building automation systems.
4. Interpret information pertaining to building automation systems found on drawings and specifications.
5. Identify tools and equipment relating to building automation systems and describe their applications and procedures for use.
6. Identify types of building automation systems and describe their characteristics and operation.
  - i) energy
  - ii) security

- iii) heating, ventilation and cooling (HVAC)
- 7. Identify building automation system components and describe their characteristics, applications and operation.
- 8. Identify the considerations and requirements for selecting building automation systems and their components.
- 9. Describe the procedures used to install and connect building automation systems and their components.
- 10. Describe the procedures used to calibrate building automation systems and their components.
- 11. Describe the procedures used to troubleshoot building automation systems and their components.
- 12. Describe the procedures used to maintain, repair and test building automation systems and their components.

Practical Objectives

N/A

**IEL-480**

## **Predictive/Preventative Maintenance**

### **Learning Outcomes:**

- Demonstrate knowledge of the procedures used to perform predictive / preventative maintenance.

### **2016 Red Seal Occupational Standard Reference:**

N/A

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Define terminology associated with predictive / preventative maintenance.
2. Identify hazards and describe safe work practices pertaining to predictive/preventative maintenance.
3. Identify tools and equipment used for predictive / preventative maintenance and describe their applications and procedures for use.
4. Identify and interpret sources of information pertaining to predictive / preventative maintenance.
  - i) manufacturers' specifications
  - ii) standards and charts
  - iii) data / historical records
5. Identify the types of maintenance programs and describe their purpose.
  - i) Preventative
  - ii) Predictive
  - iii) Proactive

6. Identify the methods of predictive maintenance.
  - i) Non-destructive testing
    - megohm meter
    - thermal
    - ultra sonic
    - microhm meter
  - ii) Vibration analysis
  - iii) Oil analysis
  
7. Record and interpret data collected during predictive / preventative maintenance.

Practical Objectives

N/A

## **IEL-485                      Automated Control Systems**

### **Learning Outcomes:**

- Demonstrate knowledge of automated control systems, their applications and operation.
- Demonstrate knowledge of data communication systems for automated control systems.
- Demonstrate knowledge of procedures for programming, configuring and optimizing automated control systems.
- Demonstrate knowledge of procedures for maintenance of automated control systems.
- Demonstrate knowledge of procedures used to install and connect automated control systems and their components.

### **2016 Red Seal Occupational Standard Reference:**

- 30.01 Installs automated control systems.
- 30.02 Maintains automated control systems.
- 30.03 Programs automated control systems.
- 30.04 Optimizes system performance.

### **Suggested Hours:**

60 Hours

### **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)
    - gray code
  
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.
18. Identify electronic components and describe their application as it pertains to automated control systems.
19. Describe the procedures to commission, startup, shutdown, and decommission automated control systems.

Practical Objectives:

1. Design, program, and execute a program for a PLC.

## IEL-490                      Pneumatic Control Systems

### Learning Outcomes:

- Demonstrate knowledge of pneumatic control systems, their components and operation.
- Demonstrate knowledge of pneumatic related calculations.
- Demonstrate knowledge of the procedures used to install pneumatic control system equipment and components.
- Demonstrate knowledge of the procedures used to maintain pneumatic control system equipment and components.

### 2016 Red Seal Occupational Standard Reference:

- 31.01 Installs pneumatic control systems.
- 31.02 Maintains pneumatic control systems.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret information pertaining to pneumatic control systems devices found on drawings and specifications.
2. Interpret documentation to determine the operation of pneumatic control systems.
3. Define terminology associated with pneumatic control systems.
4. Identify hazards and describe safe work practices pertaining to pneumatic control systems.
5. Describe schematics and their applications.

6. Interpret schematics to determine the operation of a pneumatic control system.
7. Identify tools and equipment related to pneumatic control systems and describe their applications and procedures for use.
8. Identify types of pneumatic control system components and describe their purpose and operation.
9. Describe the procedures used to perform basic inspection and maintenance of pneumatic control systems and components.
10. Describe the procedures used to troubleshoot, repair and test pneumatic control systems and components.
11. Describe the procedures used to install pneumatic control systems and their components.
12. Perform pneumatic related calculations pertaining to gas laws.
  - i) Charles law
  - ii) Boyles law
  - iii) Ideal gas law
13. Describe the procedures to commission, startup, shutdown, and decommission pneumatic control systems.

Practical Objectives

N/A

**Learning Outcomes:**

- Demonstrate knowledge of hydraulic circuits and control systems, their applications and operation.
- Demonstrate knowledge of hydraulic control systems, their components and operation.
- Demonstrate knowledge of the procedures used to maintain hydraulic control system equipment and components.
- Demonstrate knowledge of the procedures used to install hydraulic control system equipment and components.

**2016 Red Seal Occupational Standard Reference:**

31.03 Installs hydraulic control systems.

31.04 Maintains hydraulic control systems.

**Suggested Hours:**

12 Hours

**Objectives and Content:***Theoretical Objectives*

1. Define terminology associated with hydraulic circuits and controls.
2. Identify hazards and describe safe work practices pertaining to hydraulic circuits and control systems.
3. Describe schematics and their applications.
4. Interpret schematics to determine the operation of a hydraulic control system.
5. Interpret information found on drawings and specifications.
6. Interpret documentation to determine the operation of hydraulic control systems.

7. Identify tools and equipment related to hydraulic control systems and describe their applications and procedures for use.
8. Identify hydraulic control system components and describe their purpose and operation.
  - i) pumps
  - ii) motors
  - iii) actuators
  - iv) valves
  - v) accumulators
9. Describe the procedures used to perform basic inspection and maintenance of hydraulic control systems and components.
10. Describe the procedures used to troubleshoot, repair and test hydraulic systems and components.
11. Describe the procedures used to install hydraulic control systems and their components.
12. Describe the procedures to commission, startup, shutdown, and decommission hydraulic circuits and control systems.

Practical Objectives

N/A

## IEL-500

## Discrete and Analog Devices

### Learning Outcomes:

- Demonstrate knowledge of analog devices, their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, calibrate, troubleshoot, repair and test analog devices.
- Demonstrate knowledge of the procedures used to maintain and test analog control devices.

### 2016 Red Seal Occupational Standard Reference:

- 29.01 Installs discrete input/output (I/O) devices.
- 29.02 Maintains discrete input/output (I/O) devices.
- 29.03 Installs analog input/output (I/O) devices.
- 29.04 Maintains analog input/output (I/O) devices.

### Suggested Hours:

24 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify hazards and describe safe work practices pertaining to discrete control devices.
2. Interpret codes and regulations pertaining to discrete and analog control devices.
3. Interpret information pertaining to discrete and analog control devices found on drawings and specifications.
4. Explain the use of discrete versus analog devices.
5. Identify types of discrete control devices and describe their characteristics and applications.
  - i) input
    - pressure

- proximity
- level
- motion
- flow
- temperature
- vibration
- stop/start
- ii) output
  - solenoid valves
  - relays
  - indicator lights

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

- i) input
  - pressure
  - proximity
  - level
  - motion
  - flow
  - temperature
  - vibration
  - encoders
- ii) output
  - proportional valves
  - linear actuators
  - solenoid valves
  - transducers

7. Explain the use of discrete and analog control devices for measurement.

- i) pressure
- ii) temperature
- iii) flow
- iv) level
- v) mass
- vi) density

8. Identify discrete control device components and accessories and describe their characteristics and applications.
9. Identify analog control device components and accessories and describe their characteristics and applications.
10. Identify types of voltage used with discrete and analog devices and describe their characteristics, applications and operation.
11. Identify types of signals used with discrete and analog devices and describe their characteristics, applications and operation.
  - i) on/off
  - ii) resistance
  - iii) current
  - iv) voltage (sinking or sourcing)
12. Identify the considerations and requirements for selecting discrete and analog control devices, their components and accessories.
13. Describe the procedures used to install and connect discrete and analog control devices, their components and accessories.
14. Describe the procedures used to calibrate discrete and analog control devices.
15. Describe the procedures used to troubleshoot discrete and analog control devices, their components and accessories.
16. Describe the procedures used to maintain, repair and test discrete and analog control devices, their components and accessories.
17. Identify electronic components and describe their application as it pertains to discrete and analog devices.
18. Describe the procedures to commission, startup, shutdown, and decommission discrete and analog devices.

### Practical Objectives

1. Install and calibrate an analog device.

## **IEL-505                  Process Control**

### **Learning Outcomes:**

- Demonstrate knowledge of process control and its purpose.
- Demonstrate knowledge of process controllers, their components and operation.
- Demonstrate knowledge of the procedures used to install, calibrate, troubleshoot and test process controllers.
- Demonstrate knowledge of the procedures used to tune process controllers.

### **2016 Red Seal Occupational Standard Reference:**

- 30.02 Maintains automated control systems.
- 30.04 Optimizes system performance.

### **Suggested Hours:**

30 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Define terminology associated with process control.
2. Identify hazards and describe safe work practices pertaining to process control.
3. Interpret information pertaining to process control found on drawings and specifications.
4. Identify tools and equipment relating to process controllers and describe their applications and procedures for use.
5. Explain process control and its purpose.
6. Identify methods of process control and describe their applications.

7. Identify modes of process control and describe their characteristics, operation and combinations.
  - i) on-off
  - ii) proportional (P)
  - iii) integral (I)
  - iv) derivative (D)
  - v) P, I, PI, PD, PID
8. Explain process dynamics and their impact on process control.
9. Identify the considerations and requirements for selecting process controllers.
10. Describe the procedures used to install, connect, and set-up process controllers.
11. Describe the procedures used to tune process controllers.
12. Identify types of control loops and describe their operation.
  - i) closed loop
  - ii) open loop
13. Describe the procedures used to troubleshoot process controllers.
14. Identify electronic components and describe their application as it pertains to process control.
15. Describe the procedures to commission, startup, shutdown, and decommission process control.

Practical Objectives

1. Set up a control loop.

## IEL-510                      Environmental Control Systems

### Learning Outcomes:

- Demonstrate knowledge of environmental control systems, their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, calibrate, troubleshoot, maintain, repair and test environmental control systems.
- Demonstrate knowledge of the procedures used to store, handle and dispose of hazardous materials.

### 2016 Red Seal Occupational Standard Reference:

24.01 Installs non-rotating equipment and associated controls.

24.02 Maintains non-rotating equipment and associated controls.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with environmental control systems.
2. Identify hazards and describe safe work practices pertaining to environmental control systems.
3. Interpret codes and regulations pertaining to environmental control systems.
4. Interpret information pertaining to environmental control systems found on drawings and specifications.
5. Identify tools and equipment relating to environmental control systems and describe their applications and procedures for use.
6. Explain the purpose and operation of environmental control systems.

7. Identify types of environmental control systems and describe their characteristics and applications.
  - i) waste management
  - ii) noise reduction
  - iii) water treatment
  - iv) dust suppression
  - v) emissions
  
8. Identify environmental control system components and describe their characteristics and applications.
  - i) samplers
  - ii) analyzers
  - iii) scrubbers
  - iv) skimmers
  
9. Identify the considerations and requirements for selecting environmental control systems and their components.
  
10. Describe the procedures used to install and connect environmental control systems and their components.
  
11. Describe the procedures used to calibrate environmental control systems and their components.
  
12. Describe the procedures used to troubleshoot environmental control systems and their components.
  
13. Describe the procedures used to maintain, repair and test environmental control systems and their components.
  
14. Describe the procedures used to store, handle and dispose of hazardous materials.

Practical Objectives

N/A

## IEL-515                      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.

### 2016 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 Industrial 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 and maintain generating, distribution and service systems for the Industrial Electrician trade as identified in the RSOS.
    - i) consumer/supply services and metering equipment
    - ii) protection devices
    - iii) low voltage distribution systems
    - iv) power conditioning systems
    - v) grounding, bonding and ground fault detection systems
    - vi) power generating systems
    - vii) renewable energy generating and storage systems
    - viii) high voltage systems
    - ix) transformers
  7. Review process to install and maintain wiring systems for the Industrial Electrician trade as identified in the RSOS.
    - i) raceways, cables, conductors and enclosures
    - ii) branch circuitry and devices
    - iii) heating, ventilation and air-conditioning electrical components
    - iv) electric heating system controls
    - v) exit and emergency lighting systems
    - vi) cathodic protection systems
  8. Review process to install and maintain rotating and non rotating equipment for the Industrial Electrician trade as identified in the RSOS.
    - i) motor starters and control devices
    - ii) drives

- iii) non-rotating equipment and associated controls
  - iv) motors
9. Review process to install and maintain signaling and communication systems for the Industrial Electrician trade as identified in the RSOS.
- i) signaling systems
  - ii) communication systems
  - iii) building automation systems
10. Review process to install and maintain process control systems for the Industrial Electrician trade as identified in the RSOS.
- i) input/output devices
  - ii) automated control systems
  - iii) pneumatic and hydraulic control systems

Practical Objectives

N/A

## 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  
 P.O. Box 578  
 1256 Barrington St.  
 Halifax, NS B3J 2S9  
 P: 902-424-5651  
[www.nsapprenticeship.ca](http://www.nsapprenticeship.ca)

**NL:** Apprenticeship and Trades Certification  
 Dept. of Advanced Education, Skills and Labour  
 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 25, 2017	Overall Formatting/Final ATAC Approved Draft	AACS_A-v4