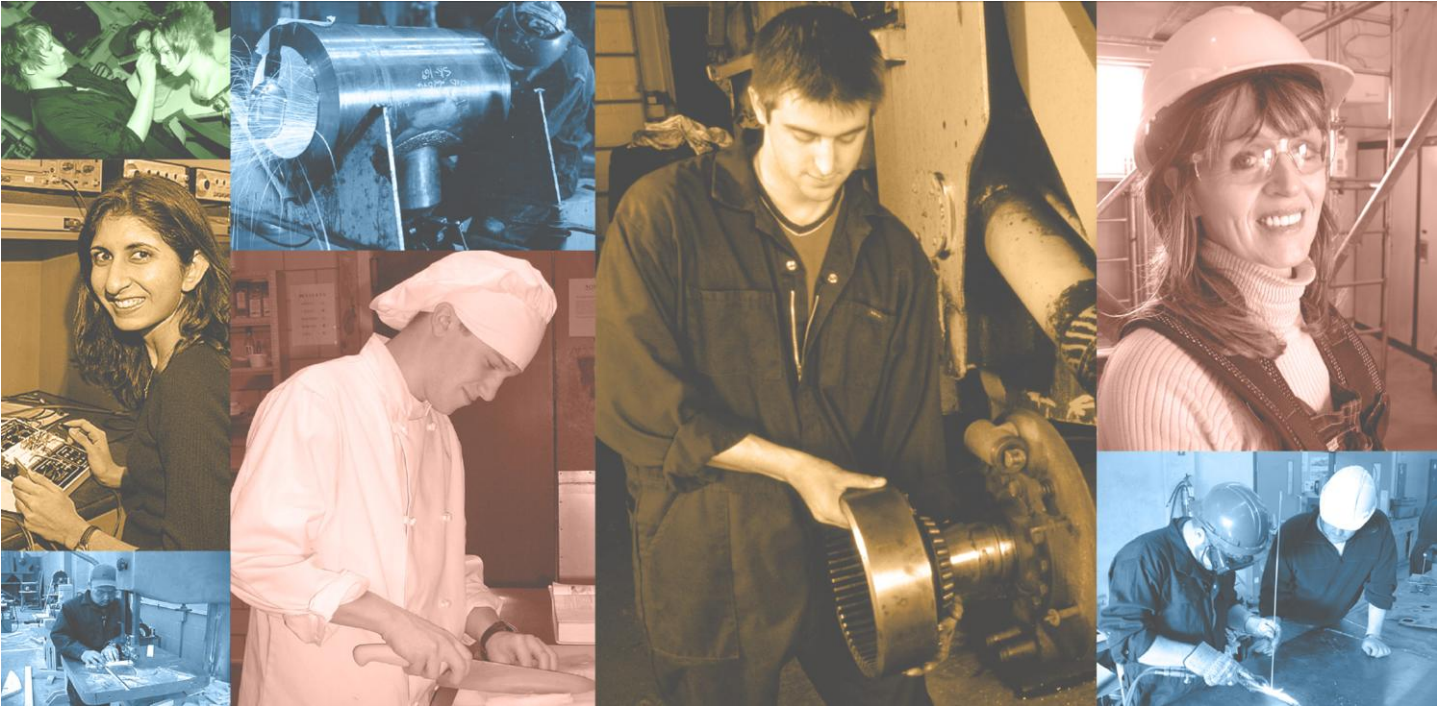

Plan of Training



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

PLAN OF TRAINING

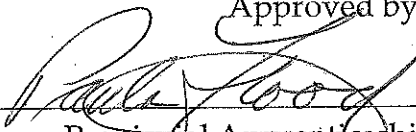
Industrial Electrician

March 2013



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

Approved by:



Chairperson, Provincial Apprenticeship and Certification Board

Date: March 26 / 13

Preface

This Apprenticeship Standard is based on the **2011** edition of the National Occupational Analysis for the Industrial Electrician trade.

This document describes the curriculum content for the Industrial Electrician apprenticeship training program and outlines each of the technical training units necessary for the completion of apprenticeship.

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Document Status

Document Status	Date Distributed	Mandatory Implementation Date	Comments
Updated	March 2014	March 2014	- Inter-change of two courses from Block I with a course from Block II. - Minor content modification to 3 additional courses.

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A. Profile Chart

COMMON OCCUPATIONAL SKILLS			
ER1411 Safety	ER1112 Tools and Equipment	ER1105 Access Equipment	ER1101 Hoisting, Lifting and Rigging
ER1202 Drawings, Schematics and Specifications	ER1212 Electrical Drawings and Schematics	ER1161 Introduction to the Canadian Electrical Code	MC1060 Intro to Computer Use
ER1231 Conductors and Cables	ER1221 Conduit, Tubing and Fittings	ER2001 Raceways, Wireways and Busways	ER1580 Job Planning
ER2391 Fiber Optics	ER4240 Introduction to Commissioning	ER1242 Fundamental Wiring	ER1140 DC Theory
ER1180 Single-Phase Theory	ER1190 Three-Phase Theory	ER1590 Introduction to Communication and Trade Documentation	
POWER DISTRIBUTION AND GENERATING SYSTEMS			
ER4120 High Voltage Breakers and Starters	ER1262 Transformers	ER1371 Distribution Equipment	ER1570 Grounding and Bonding
ER4140 High Voltage Wiring	ER1170 Voltage Drop and Power Loss	ER1271 Single-Phase Service Entrance	ER1281 Three-Phase Service Entrance

ELECTRICAL EQUIPMENT			
ER1250 Protective Devices	ER1301 DC Motors and Controls	ER2022 Single-Phase Motors	ER2031 Three-Phase Motors
ER2051 Motor Starters and Controls I	ER2055 Motor Starters and Controls II	ER4400 Drives	ER2351 Electric Surface Heating Systems
ER4200 Cathodic Protection Systems	ER4320 Vibration Analysis	ER4260 Digital Electronics	ER1151 Series and Parallel DC Circuits
ER2074 Power Supply and Rectifiers	ER4440 Introduction to Analog Devices		
EMERGENCY AND STANDBY SYSTEMS			
ER4180 Emergency Stand-by Units	ER2241 DC Generators	ER2251 AC Generators	ER4420 Alternative Power Systems
COMMUNICATION SYSTEMS			
ER1341 Fire Alarms	ER2142 Security Systems	ER2134 Communication Systems	ER4160 Exit/Emergency Lighting Systems
PROCESS CONTROL SYSTEMS			
ER4460 Analog Devices	ER2042 Discrete Control Devices	ER4480 Process Control	ER4360 Introduction to Programmable Logic Controllers
ER4300 Hydraulic Circuits and Control Systems	ER4280 Pneumatic Control Systems	ER4100 Distribution System Conditioning	ER4380 Introduction to Programmable Logic Controller Programming

BUILDING AND ENVIRONMENTAL CONTROL SYSTEMS			
ER2710 Heating, Ventilation and Cooling Systems	ER2720 Heating, Ventilation and Cooling System Controls	ER4340 Environmental Control Systems	ER4220 Building Automation Systems
ER2011 Lighting Systems and Controls	ER2500 Explosion Proof Equipment		

B. NOA Comparison Chart

2011 NOA Tasks		2013 POT
Task 1 - Performs Safety-Related Functions		
1.01	Maintains safe work environment	ER1411 – Safety
1.02	Uses personal protective equipment (PPE) and safety equipment	ER1411 – Safety ER1101 – Hoisting, Lifting and Rigging
1.03	Performs lock-out and tagging procedures	ER1411 – Safety ER1242 – Fundamental Wiring
Task 2 - Uses and Maintains Tools and Equipment		
2.01	Maintains tools and equipment	ER1112 – Tools and Equipment
2.02	Uses access equipment	ER1105 – Access Equipment ER1101 – Hoisting, Lifting and Rigging
2.03	Uses rigging, tugging, hoisting and lifting equipment	
Task 3 - Organizes Work		
3.01	Interprets codes and regulations	ER1411 – Safety TS1520 – WHMIS ER1161 – Introduction to the Canadian Electrical Code
3.02	Uses plans, schematics, drawings and specifications	ER1202 – Drawings, Schematics and Specifications ER1212 – Electrical Drawings and Schematics ER1242 – Fundamental Wiring
3.03	Selects materials and supplies	ER2011 – Lighting Systems and Controls ER1580 – Job Planning ER2051 – Motor Starters and Control I ER2055 – Motor Starters and Control II
3.04	Plans project tasks and procedures	ER1580 – Job Planning ER1242 – Fundamental Wiring
3.05	Prepares work site	ER1411 – Safety ER1105 – Access Equipment ER1101 – Hoisting, Lifting and Rigging ER1590 – Introduction to Communication and Trade Documentation ER1242 – Fundamental Wiring ER1580 – Job Planning
3.06	Documents maintenance work	ER1411 – Safety ER1590 – Introduction to Communication and Trade Documentation

2011 NOA Tasks		2013 POT
Task 4 -Performs Routine Trade Activities		
4.01	Installs fasteners, fittings and connectors	ER1231 – Conductors and Cables ER1221 – Conduit, Tubing and Fittings ER2001 – Raceways, Wireways and Busways ER1112 – Tools and Equipment
4.02	Conducts operational tests	ALL Lab courses
Task 5 - Maintains High Voltage Power Distribution Systems		
5.01	Installs high voltage power distribution systems	NOT COMMON CORE
5.02	Services high voltage power distribution systems	ER4120 – High Voltage Breakers and Starters ER4140 – High Voltage Wiring
5.03	Troubleshoots high voltage power distribution systems	
5.04	Repairs high voltage power distribution systems	
Task 6 - Maintains Low Voltage Power Distribution Systems		
6.01	Installs low voltage power distribution systems	ER1371 – Distribution Equipment ER1281 – Three-Phase Service Entrance ER1242 – Fundamental Wiring ER4100 – Distribution System Conditioning ER4420 – Alternate Power Sources
6.02	Services low voltage power distribution systems	
6.03	Troubleshoots low voltage power distribution systems	
6.04	Repairs low voltage power distribution systems	
Task 7 - Maintains Alternating Current (AC) Systems		
7.01	Installs AC systems	ER1231 – Conductors and Cables ER1570 – Grounding and Bonding ER1242 – Fundamental Wiring ER1190 – Three-Phase Theory ER1170 – Voltage Drop and Power Loss
7.02	Services AC systems	
7.03	Troubleshoots AC systems	
7.04	Repairs AC systems	
Task 8 - Maintains Direct Current (DC) Systems		
8.01	Installs DC systems	ER1140 – DC Theory ER1151 – Series and Parallel DC Circuits ER1301 – DC Motors and Controls ER2241 – DC Generators ER2074 – Power Supply and Rectifiers
8.02	Services DC systems	
8.03	Troubleshoots DC systems	
8.04	Repairs DC systems	

2011 NOA Tasks		2013 POT
Task 9 - Maintains Grounding And Bonding Systems		
9.01	Installs grounding and bonding systems	ER1570 – Grounding and Bonding ER2011 – Lighting Systems and Controls ER1371 – Distribution Equipment ER1271 – Single-Phase Service Entrance ER1281 – Three-Phase Service Entrance ER4140 – High Voltage Wiring
9.02	Services grounding and bonding systems	
9.03	Troubleshoots grounding and bonding systems	
9.04	Repairs grounding and bonding systems	
Task 10 - Maintains Power Generating Systems		
10.01	Installs power generating systems	NOT COMMON CORE
10.02	Services power generating systems	ER2251 – AC Generators ER2241 – DC Generators ER4180 – Emergency Stand-by Units ER4420 – Alternate Power Sources
10.03	Troubleshoots power generating systems	
10.04	Repairs power generating systems	
Task 11 - Maintains Equipment, Wiring, Cabling, and Terminations		
11.01	Installs electrical wiring, cabling, and terminations	ER1231 – Conductors and Cables ER1570 – Grounding and Bonding ER1221 – Conduit, Tubing and Fittings ER2001 – Raceways, Wireways and Busways ER1242 – Fundamental Wiring ER1271 – Single-Phase Service Entrance ER1281 – Three-Phase Service Entrance ER4140 – High Voltage Wiring
11.02	Installs raceways, cable trays, busways and associated components	
11.03	Repairs electrical wiring, cabling, and terminations	
11.04	Maintains seismic restraint systems	NOT COMMON CORE
Task 12 - Maintains Lighting Systems		
12.01	Installs lighting systems	ER2011 – Lighting Systems and Controls ER4160 – Exit/Emergency Lighting Systems
12.02	Services lighting systems	
12.03	Troubleshoots lighting systems	
12.04	Repairs lighting systems	

2011 NOA Tasks		2013 POT
Task 13 - Maintains Protection Devices		
13.01	Installs protection devices	ER1250 – Protective Devices ER1242 – Fundamental Wiring ER1371 – Distribution Equipment ER2051 – Motors Starters and Control I ER4120 – High Voltage Breakers and Starters ER4320 – Vibration Analysis ER4200 – Cathodic Protection Systems
13.02	Services protection devices	
13.03	Troubleshoots protection devices	
13.04	Repairs protection devices	
Task 14 - Maintains Rotating Equipment and Associated Controls		
14.01	Installs rotating equipment and associated controls	ER2022 – Single-Phase Motors ER2031 – Three-Phase Motors ER1301 – DC Motors and Controls ER2042 – Discrete Control Devices ER2051 – Motors Starters and Control I ER2055 – Motors Starters and Control II ER2074 – Power Supply and Rectifiers ER4120 – High Voltage Breakers and Starters
14.02	Services rotating equipment and associated controls	
14.03	Troubleshoots rotating equipment and associated controls	
14.04	Repairs rotating equipment and associated controls	
Task 15 - Maintains Drives And Associated Controls		
15.01	Installs drives and associated controls	ER4400 – Drives
15.02	Services drives and associated controls	
15.03	Troubleshoots drives and associated controls	
15.04	Repairs drives and associated controls	

2011 NOA Tasks		2013 POT
Task 16 - Maintains Non-Rotating Equipment and Associated Controls		
16.01	Installs non-rotating equipment and associated controls	ER1262 – Transformers ER2042 – Discrete Control Devices ER2051 – Motors Starters and Control I ER2055 – Motors Starters and Control II ER2074 – Power Supply and Rectifiers ER4260 – Digital Electronics ER4280 – Pneumatic Control Systems ER4320 – Vibration Analysis ER4340 – Environmental Control Systems ER4220 – Building Automation Systems ER4360 – Introduction to Programmable Logic Controllers ER4380 – Introduction to Programmable Logic Controller Programming
16.02	Services non-rotating equipment and associated controls	
16.03	Troubleshoots non-rotating equipment and associated controls	
16.04	Repairs non-rotating equipment and associated controls	
Task 17 - Maintains Uninterruptible Power Supply (UPS) Systems		
17.01	Installs UPS systems	ER4180 – Emergency Stand-by Units ER4160 – Exit/Emergency Lighting Systems
17.02	Services UPS systems	
17.03	Troubleshoots UPS systems	
17.04	Repairs UPS systems	
Task 18 - Maintains Standby Power Generating Systems		
18.01	Installs standby power generating systems	ER4180 – Emergency Stand-by Units ER4160 – Exit/Emergency Lighting Systems
18.02	Services standby power generating systems	
18.03	Troubleshoots standby power generating systems	
18.04	Repairs standby power generating systems	
Task 19 - Maintains Alarm Systems		
19.01	Installs alarm systems	ER1341 – Fire Alarm Systems ER2142 – Security Systems
19.02	Services alarm systems	
19.03	Troubleshoots alarm systems	
19.04	Repairs alarm systems	

2011 NOA Tasks		2013 POT
Task 20 - Maintains Paging Systems		
20.01	Installs paging systems	ER2134 – Communication Systems
20.02	Services paging systems	
20.03	Troubleshoots paging systems	
20.04	Repairs paging systems	
Task 21 - Maintains Multimedia Systems		
21.01	Installs multimedia systems	NOT COMMON CORE
21.02	Services multimedia systems	
21.03	Troubleshoots multimedia systems	
21.04	Repairs multimedia systems	
Task 22 - Maintains Network Systems		
22.01	Installs network systems	ER2134 – Communication Systems
22.02	Services network systems	
22.03	Troubleshoots network systems	
22.04	Repairs network systems	
Task 23 - Maintains Input / Output (I/O) Field Devices		
23.01	Installs I/O field devices	ER4360 – Introduction to Programmable Logic Controllers
23.02	Services I/O field devices	
23.03	Troubleshoots I/O field devices	ER4380 – Introduction to Programmable Logic Controller Programming
23.04	Repairs I/O field devices	ER4460 – Analog Devices
Task 24 - Maintains Control Systems		
24.01	Installs control systems	ER2042 – Discrete Control Devices ER2051 – Motors Starters and Control I ER2055 – Motors Starters and Control II ER2011 – Lighting Systems and Controls ER1301 – DC Motors and Controls ER4280 – Pneumatic Control Systems ER4300 – Hydraulic Circuits and Control Systems ER4340 – Environmental Control Systems ER4220 – Building Automation Systems ER4360 – Introduction to Programmable Logic Controllers ER4380 – Introduction to Programmable Logic Controller Programming ER4460 – Analog Devices ER4480 – Process Control
24.02	Services control systems	
24.03	Troubleshoots control systems	
24.04	Repairs control systems	

2011 NOA Tasks		2013 POT
Task 24 - Maintains Control Systems.....Continued		
24.05	Optimizes programmable logic controller (PLC)	ER4360 – Introduction to Programmable Logic Controllers ER4380 – Introduction to Programmable Logic Controller Programming ER4480 – Process Control
Task 25 - Maintains Electrical Components of Heating and Cooling Systems		
25.01	Installs electrical components of heating and cooling systems	ER4340 – Environmental Control Systems ER4220 – Building Automation Systems ER2710 – Heating, Ventilation and Cooling Systems ER2720 – Heating, Ventilation and Cooling System Controls ER2351 – Electric Surface Heating Systems
25.02	Services electrical components of heating and cooling systems	
25.03	Troubleshoots electrical components of heating and cooling systems	
25.04	Repairs electrical components of heating and cooling systems	
Task 26 - Maintains Building Automation Systems		
26.01	Installs building automation systems	ER4220 – Building Automation Systems
26.02	Services building automation systems	
26.03	Troubleshoots building automation systems	
26.04	Repairs building automation systems	
Task 27 - Maintains Environmental Control Systems		
27.01	Installs environmental control systems	ER4340 – Environmental Control Systems
27.02	Services environmental control systems	
27.03	Troubleshoots environmental control systems	
27.04	Repairs environmental control systems	

C. Program Structure

For each and every course, a formal assessment is required for which 70% is the pass mark. A mark of 70% must be attained in both the theory examination and the practical project assignment, where applicable as documented on an official transcript.

The order of course delivery within each block can be determined by the educational agency, as long as pre-requisite conditions are satisfied.

Upon completion of an entry level program, individuals may be required to complete other certifications (employer or job site specific) in order to gain employment.

Entry Level – Block I				
Course No.	IPG No.	Course Name	Hours	Pre-Requisite(s)
TS1520	-	WHMIS	6	None
TS1530	-	Standard First Aid	14	None
ER1411	ELE-100	Safety	30	None
ER1112	ELE-105	Tools and Equipment	15	ER1411 TS1530
ER1105	ELE-110	Access Equipment	12	ER1411
ER1101	ELE-115	Hoisting, Lifting and Rigging	18	ER1411
ER1202	ELE-125	Drawings, Schematics and Specifications	30	None
ER1212	-	Electrical Drawings and Schematics	30	ER1202
ER1161	ELE-130	Introduction to the Canadian Electrical Code	24	None
ER1140	ELE-140	DC Theory	30	ER1411 ER1112
ER1151	ELE-145	Series and Parallel DC Circuits	45	ER1140
ER1180	ELE-200 ELE-210	Single-Phase Theory	60	ER1151

Entry Level – Block I				
Course No.	IPG No.	Course Name	Hours	Pre-Requisite(s)
ER1231	ELE-150	Conductors and Cables	30	ER1411 ER1161
ER1570	ELE-155	Grounding and Bonding	6	ER1161
ER1221	ELE-160	Conduit, Tubing and Fittings	30	ER1161
ER2001	ELE-165	Raceways, Wireways and Busways	30	ER1411 ER1161
ER1242	ELE-170	Fundamental Wiring	60	ER1411 ER1161 ER1112
ER2011	ELE-175	Lighting Systems and Controls	25	ER1242
ER1190	ELE-205	Three-Phase Theory	30	ER1180
ER1170	ELE-220	Voltage Drop and Power Loss	30	ER1190
ER1271	ELE-225	Single-Phase Service Entrance	30	ER1242
ER1371	ELE-230	Distribution Equipment	17	ER1190
ER1250	ELE-235	Protective Devices	30	ER1190
ER2022	ELE-250	Single-Phase Motors	30	ER1180
ER1580	ELE-260	Job Planning	6	ER1411 ER1212 ER1161
ER1281	ELE-340	Three-Phase Service Entrance	30	ER1271 ER1190
ER2351	ELE-310	Electric Surface Heating Systems	15	ER1242 ER1161
ER1262	ELE-350	Transformers	60	ER1190
ER2391	ELE-455	Fiber Optics	18	ER1242
ER1341	ELE-440	Fire Alarms	20	ER2391

Entry Level – Block I				
Course No.	IPG No.	Course Name	Hours	Pre-Requisite(s)
ER2142	ELE-445	Security Systems	10	ER2391
ER2134	ELE-450	Communication Systems	20	ER2391
ER1590	ELE-120	Introduction to Communication and Trade Documentation	6	ER1580
*AM1100	-	Math Essentials	30	None
AM1160	-	Electrician Math Fundamentals	30	AM1000
CM2160	-	Communication Essentials	45	None
SD1760	-	Workplace Essentials	45	None
MC1060	-	Computer Essentials	15	None
AP1101	-	Introduction to Apprenticeship	15	None
OT1150	-	Workterm	80	None

Total Hours	1107
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Required Work Experience

Block II				
Course No.	IPG No.	Course Name	Hours	Pre-Requisite(s)
ER2042	ELE-255	Discrete Control Devices	12	Block I
ER2710	ELE-300	Heating, Ventilation and Cooling Systems	15	Block I
ER2720	ELE-305	Heating, Ventilation and Cooling System Controls	18	ER2710
ER2051	ELE-245	Motor Starters and Controls I	42	ER2042
ER2055	ELE-325	Motor Starters and Controls II	18	ER2051
ER1301	ELE-315	DC Motors and Controls	20	ER2051
ER2241	ELE-320	DC Generators	10	ER1301
ER2074	ELE-215	Power Supply and Rectifiers	58	Block I
ER2031	ELE-330	Three-Phase Motors	30	Block I
ER2251	ELE-335	AC Generators	20	ER2031
Total Hours			243	

Required Work Experience

Block III				
Course No.	IPG No.	Course Name	Hours	Pre-Requisite(s)
ER4260	IEL-360	Digital Electronics	30	Block II
ER4280	IEL-370	Pneumatic Control Systems	30	Block II
ER4100	ELE-420	Distribution System Conditioning	30	Block II
ER4120	ELE-410	High Voltage Breakers and Starters	15	Block II
ER4140	ELE-415	High Voltage Wiring	15	ER4120
ER4300	IEL-365	Hydraulic Circuits and Control Systems	6	Block II
ER4320	IEL-355	Vibration Analysis	6	Block II
ER4160	ELE-240	Exit / Emergency Lighting Systems	10	Block II
ER4180	ELE-345	Emergency Stand-by Units	25	Block II
ER4200	ELE-435	Cathodic Protection Systems	6	Block II
ER4340	IEL-475	Environmental Control Systems	15	Block II
ER4220	IEL-480	Building Automation Systems	15	Block II
ER2500	-	Explosion Proof Equipment	30	Block II
ER4240	ELE-460	Introduction to Commissioning	6	Block II
Total Hours			239	

Required Work Experience

Block IV				
Course No.	IPG No.	Course Name	Hours	Pre-Requisite(s)
ER4360	ELE-400	Introduction to Programmable Logic Controllers	22	Block III
ER4380	ELE-405	Introduction to Programmable Logic Controller Programming	30	ER4360
ER4440	-	Introduction to Analog Devices	20	ER4380
ER4460	IEL-465	Analog Devices	90	ER4440
ER4480	IEL-470	Process Control	42	ER4460
ER4400	ELE-425	Drives	30	ER4460
ER4420	ELE-430	Alternative Power Systems	6	Block III

Total Hours	240
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Total Course Credit Hours	1829
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***A student who can meet the Mathematics requirement through an ACUPLACER® test may be exempted from AM1100 – Math Essentials. Please check with your training institution.**

BLOCK I

TS1520 Workplace Hazardous Materials Information System (WHMIS)

Learning Outcomes:

- Demonstrate knowledge of interpreting and applying the Workplace Hazardous Materials Information System (WHMIS) Regulation under the Occupational Health and Safety Act.

Duration: 6 Hours

Pre-Requisite(s): None

Objectives and Content:

1. Define WHMIS safety.
 - i. rational and key elements
 - ii. history and development of WHMIS
 - iii. WHMIS legislation
 - iv. WHMIS implementation program
 - v. definitions of legal and technical terms
2. Examine hazard identification and ingredient disclosure.
 - i. prohibited, restricted and controlled products
 - ii. classification and the application of WHMIS information requirements

- iii. responsibilities for classification
 - the supplier
 - the employer
 - the worker - Classification: rules and criteria
 - information on classification
 - classes, divisions and subdivision in WHMIS
 - general rules for classification
 - class A - compressed gases
 - class B - flammable and combustible materials
 - class C - oxidizing material
 - class D - poisonous and infectious material
 - class E - corrosive material
 - class F - dangerously reactive material
 - iv. products excluded from the application of WHMIS legislation
 - consumer products
 - explosives
 - cosmetics, drugs, foods and devices
 - pest control products
 - radioactive prescribed substances
 - wood or products made of wood
 - manufactured articles
 - tobacco or products of tobacco
 - hazardous wastes
 - products handled or transported pursuant to the Transportation of Dangerous Goods (TDG) Act
 - v. comparison of classification systems - WHMIS and TDG
 - vi. general comparison of classification categories
 - vii. detailed comparison of classified criteria
3. Explain labeling and other forms of warning.
- i. definition of a WHMIS label
 - supplier label
 - workplace label
 - other means of identification
 - ii. responsibility for labels
 - supplier responsibility
 - employer responsibility
 - worker responsibility

- iii. introduce label content, design and location
 - supplier labels
 - workplace labels
 - other means of identification

- 4. Introduce material safety data sheets (MSDS).
 - i. definition of a material safety data sheet
 - ii. purpose of the data sheet
 - iii. responsibility for the production and availability of data sheets
 - supplier responsibility
 - employer responsibility
 - workers responsibility

Practical Requirements:

- 1. Locate WHMIS label and interpret the information displayed.

- 2. Locate a MSDS sheet for a product used in the workplace and determine what personal protective equipment and other precautions are required when handling this product.

TS1530 Standard First Aid

Learning Outcomes:

- Demonstrate knowledge of recognizing situations requiring emergency action
- Demonstrate knowledge of making appropriate decisions concerning first aid

Duration: 14 Hours

Pre-Requisite(s): None

Practical Requirements:

1. Complete a **St. John Ambulance or Canadian Red Cross** Standard First Aid Certificate course.

ER1411 Safety

Learning Outcomes:

- Demonstrate knowledge of safety equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of safe work practices.
- Demonstrate knowledge of regulatory requirements pertaining to safety.

Duration: 30 Hours

Pre-Requisite(s): None

Objectives and Content:

1. Identify types of personal protective equipment (PPE) and clothing and describe their applications and limitations.
2. Describe the procedures used to care for and maintain PPE.
3. Identify hazards and describe safe work practices.
 - i. personal
 - Job Safety Analysis (JSA)
 - Tool box meetings
 - ii. workplace
 - energy state awareness (electrical & mechanical)
 - arc flash awareness (CSA - Workplace Electrical Safety (Standard) Z462-08)
 - isolation and de-energizing procedures
 - lockout / tag out
 - confined space awareness
 - fire
 - heights (fall arrest)
 - chemical / gas / radiation
 - asbestos

- iii. environmental
 - discharge/spills
- 4. Describe basic employer and employee duties to comply with the applicable Act and safety regulations. (91-448 of OH&S Regulations)
 - i. employers responsibilities
 - ii. supervisors responsibilities
 - iii. employees rights and responsibilities
 - iv. Health and Safety Committee responsibilities
- 5. Identify and describe workplace safety and health regulations.
 - i. federal
 - ii. provincial/territorial
 - iii. municipal

Practical Requirements:

- 1. Perform isolation and de-energizing procedures and lockout / tag out.
- 2. Identify and tag out faulty equipment.

ER1112 Tools and Equipment

Learning Outcomes:

- Demonstrate knowledge of tools and equipment, their applications, maintenance and procedures for use.

Duration: 15 Hours

Pre-Requisite(s): TS1530, ER1411

Objectives and Content:

1. Identify types of hand tools and describe their applications and procedures for use.
2. Describe the procedures used to inspect and maintain hand tools.
3. Identify types of power tools and describe their applications and procedures for use.
 - i. electric
 - ii. hydraulic
 - iii. pneumatic
4. Describe the procedures used to inspect and maintain power tools.
5. Identify types of basic electrical measuring and test equipment and describe their general applications.
6. Describe the procedures used to inspect and maintain electrical measuring and test equipment.
7. Identify types of powder actuated tools and describe their applications.

8. Identify types of calibration, configuration and test equipment and describe their applications.
9. Identify types of installation and mounting hardware and describe their applications.

Practical Requirements:

1. Selection and proper use of various hand tools.
2. Selection and proper use of various power tools.
3. Demonstrate proper use of powder actuated tools.

ER1105 Access Equipment

Learning Outcomes:

- Demonstrate knowledge of ladders, scaffolding and hydraulic lifts, their applications, limitations and procedures for use.

Duration: 12 Hours

Pre-Requisite(s): ER1411

Objectives and Content:

1. Define terminology associated with ladders, scaffolding and hydraulic lifts.
2. Identify hazards and describe safe work practices pertaining to ladders, scaffolding and hydraulic lifts.
 - i. fall arrest
3. Identify codes and regulations pertaining to ladders, scaffolding and hydraulic lifts.
 - i. training and certification requirements
4. Identify types of ladders, scaffolding and hydraulic lifts and describe their characteristics and applications.
5. Describe the procedures used to erect and dismantle ladders and scaffolding.
6. Describe the procedures used to inspect, maintain and store ladders, scaffolding and hydraulic lifts.

Practical Requirements:

None.

ER1101 Hoisting, Lifting and Rigging

Learning Outcomes:

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

Duration: 18 Hours

Pre-Requisite(s): ER1411

Objectives and Content:

1. Define terminology associated with hoisting, lifting and rigging.
2. Identify hazards and describe safe work practices pertaining to hoisting, lifting and rigging.
3. Identify hazards and describe safe work practices pertaining to mobile and overhead cranes.
4. Identify codes and regulations pertaining to hoisting, lifting and rigging.
 - i. training and certification requirements
5. Identify types of rigging equipment and accessories and describe their applications and procedures for use.
6. Identify types of hoisting and lifting equipment and accessories and describe their applications and procedures for use.
 - i. chain fall
 - ii. come along
7. Describe the procedures used to inspect, maintain and store hoisting, lifting and rigging equipment.

8. Identify types of knots, hitches, splices and bends and describe their applications and the procedures used to tie them.
9. Describe the considerations when rigging material/equipment for lifting.
 - i. load characteristics
 - ii. equipment and accessories
 - iii. environmental factors
 - iv. anchor points
 - v. sling angles
10. Describe the procedures used to ensure the work area is safe for lifting.
 - i. supervision of lifts
 - ii. securing work area
 - iii. communication
 - iv. OSHA requirements
11. Identify and describe procedures used to communicate during hoisting, lifting and rigging operations.
 - i. hand signals (awareness of)
 - ii. electronic communications
 - iii. audible/visual
 - iv. OSHA requirements

Practical Requirements:

1. Tie knots, bends, and hitches used for lifting and moving equipment.
2. Inspect, select and use the appropriate sling to perform a given task.

ER1202 Drawings, Schematics and Specifications

Learning Outcomes:

- Demonstrate knowledge of drawings, schematics and specifications and their applications.
- Demonstrate knowledge of interpreting and extracting information from drawings, basic schematics and specifications.

Duration: 30 Hours

Pre-Requisite(s): None

Objectives and Content:

1. Define terminology associated with drawings, schematics and specifications.
2. Identify types of drawings and describe their applications.
 - i. civil/site
 - ii. architectural
 - iii. mechanical
 - iv. structural
 - v. electrical
 - vi. shop drawings
 - vii. sketches
 - viii. as-builts
3. Interpret and extract information from drawings.
 - i. alphabet of lines
 - ii. elevations
 - iii. scales
 - iv. legends
 - v. symbols and abbreviations
 - vi. notes and specifications
4. Interpret and extract information from basic schematics and specifications.

5. Describe the function of a CAD system.
6. Identify documentation requirements for modifying drawings and specifications.
7. Describe the procedures used to document changes made to equipment and wiring.

Practical Requirements:

1. Gather and interpret information from various drawings.
2. Determine measurements from scaled drawings.
3. Sketch basic drawing views.

ER1212 Electrical Drawings and Schematics

Learning Outcomes:

- Demonstrate knowledge of advanced drawings and schematics and their applications.
- Demonstrate knowledge of interpreting and extracting information from advanced drawings and basic schematics.

Duration: 30 Hours

Pre-Requisite(s): ER1202

Objectives and Content:

1. Identify types of drawings and describe their applications.
 - i. piping and instrument drawings (P & IDs)
 - ii. installation drawings
 - iii. loop drawings
 - iv. location drawings
 - v. basic ladder logic (hard wire)
2. Review and interpret information from distribution system layout drawings.
 - i. switchboards/substations
 - ii. metering centers
 - iii. component tables
3. Review and interpret information from single-line drawings.
 - i. feeder size/risers
 - ii. transformers
 - voltage ratings
 - capacity
 - connections

- iii. panel board designations
 - iv. distribution boards
 - v. connected apparatus
 - vi. equipment layout elevations
 - vii. fire alarm systems
 - viii. communication and security systems
 - ix. energy management systems
4. Review and interpret information from motor control center diagrams.
 - i. starter/controller locations
 - ii. wiring diagrams (generic)
 - iii. overload/overcurrent
 - iv. conductor sizes
 - v. interconnections/interlocking
 5. Describe procedures used to obtain material lists.

Practical Requirements:

1. Extract and interpret information from:
 - i. site plans
 - ii. elevation/floor plans
 - iii. distribution system layout drawings
 - iv. single-line drawings
 - v. equipment schedules
 - vi. equipment shop drawings
2. Determine measurements from scaled drawings.
3. Extract information from project documents.
4. Interpret reference/key diagrams used on drawings.
5. Use information to obtain a materials list for installation.

ER1161 Introduction to the Canadian Electrical Code

Learning Outcomes:

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

Duration: 24 Hours

Pre-Requisite(s): None

Objectives and Content:

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
4. Locate and interpret information in the CEC.

Practical Requirements:

1. Locate and select information from the CEC, Part 1.
2. Locate and select information from the CEC Handbook.

ER1140 DC Theory

Learning Outcomes:

- Demonstrate knowledge of direct current (DC) electricity, its characteristics and associated principles.
- 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.

Duration: 30 Hours

Pre-Requisite(s): ER1411, ER1112

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to DC electricity.
2. Describe the atomic structure of matter.
 - i. electron theory
 - matter
 - atoms
 - electric charge
 - protons, electrons, neutron
 - ii. static electricity and electrostatics
 - positive and negative charge
 - electrostatic field
 - transferring static electricity
 - conduction
 - induction
 - iii. discharging static charges
 - electrons in motion
 - causes of current
 - conductors, semi-conductors, insulators
 - electron current flow
 - conventional current flow

3. Identify electrical units of measure and symbols.
 - i. absolute electrical units
 - current
 - voltage
 - resistance
 - ii. prefixes for absolute units

4. Identify different forms of energy and describe the effects of dynamic electricity.
 - i. different forms of energy to produce electricity
 - chemical action
 - piezoelectric effect
 - magnetism
 - heat
 - light and solar energy
 - friction
 - ii. effects of dynamic electricity
 - heating effects
 - chemical effects
 - magnetic effects
 - psychological and physiological effects

5. Identify and analyze the components necessary for the assembly of an electric circuit.
 - i. the electron path (conductors)
 - ii. the load
 - iii. the source
 - iv. the control
 - v. closed circuit
 - vi. open circuit
 - vii. short circuit

6. Identify and describe the three basic electrical properties.
 - i. voltage
 - ii. current
 - iii. resistance

7. Explain Ohm's Law.

8. Describe the following in relation to electricity.
 - i. work
 - ii. power
 - iii. joules and coulombs
 - iv. electrical power (watt)
 - v. combination of the Power formulas and Ohm's Law
 - vi. watts and horsepower
 - vii. BTU
 - viii. kilowatt hours
 - meter reading and cost

9. Identify measuring instruments and describe their applications and procedures for use.
 - i. ammeter
 - ii. voltmeter
 - iii. ohmmeter
 - iv. multimeter
 - v. circuit tester
 - vi. continuity tester
 - vii. megger

Practical Requirements:

1. Compute values of electrical energy and power.

2. Use electrical measuring instruments.

3. Use instruments to troubleshoot DC components
 - i. closed circuit
 - ii. open circuit
 - iii. short circuit

4. Ensure calibration of measuring instruments in accordance with manufacturing specifications.

5. Conduct megger test.

ER1151 Series and Parallel DC Circuits

Learning Outcomes:

- Demonstrate knowledge of series, parallel and complex DC circuits, their characteristics and operation.
- Demonstrate knowledge of the procedures used to troubleshoot DC circuits.
- Demonstrate knowledge of the procedures used to analyze and measure DC circuit values.

Duration: 45 Hours

Pre-Requisite(s): ER1140

Objectives and Content:

1. Describe the characteristics of a series circuit and calculate values.
 - i. Resistance
 - ii. current
 - iii. voltage
 - iv. power
 - v. open resistor
 - vi. shorted resistor
2. Describe the characteristics of a parallel circuit and calculate values.
 - i. resistance
 - ii. current
 - iii. voltage
 - iv. power
 - v. open resistor
 - vi. shorted resistor
3. Identify hazards and describe safe practices pertaining to DC electricity.
4. Interpret information pertaining to DC circuits found on drawings and specifications.

5. Explain Kirchhoff's Laws.
 - i. current law
 - ii. voltage law
6. Describe the characteristics of a combination circuit and calculate values.
7. Describe the procedures used to troubleshoot series, parallel and complex DC circuits.

Practical Requirements:

1. Analyze and measure amperage and voltage in series DC circuits.
2. Analyze and measure amperage and voltage in parallel DC circuits.
3. Analyze and measure amperage and voltage in combination DC circuits.
4. Analyze and measure resistance and/or continuity in basic DC circuits.
5. Analyze and measure power consumption in basic DC circuits.

ER1180 Single-Phase Theory

Learning Outcomes:

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

Duration: 60 Hours

Pre-Requisite(s): ER1151

Objectives and Content:

1. Describe the principles of magnetism and the action of magnets.
 - i. magnetic and nonmagnetic substances categories
 - magnetic and nonmagnetic substances
 - poles of a magnet and the earth
 - ii. the theory of magnetism
 - magnetized and unmagnetized
 - magnetic field
 - magnetic lines
 - iii. magnetism properties
 - flux density (Weber's theory)
 - forces between magnetic poles
 - induced magnetism
 - permeability
 - reluctance
 - shielding
 - permanent and temporary magnet
 - retentivity
 - residual magnetism
 - demagnetizing

2. Describe the principles of electromagnetism.
 - i. the theory of electromagnetism
 - characteristics of an electromagnetic field
 - magnetic field around a current-carrying conductor
 - ii. direction of current flow and magnetic flux
 - direction of current and flux
 - dot-cross method
 - left-hand conductor rule
 - electromagnetic coil
 - left-hand coil rule
 - iii. the electromagnet
 - characteristic of electromagnets (core, turns, strength)
 - magnetic saturation
 - core losses (hysteresis, eddy current, I^2R)
 - uses of electromagnets

3. Describe the principles and characteristics of electromagnetic induction.
 - i. principles of electromagnetic induction
 - Faraday's law
 - factors affecting amount of induced voltage
 - ii. self and mutual induction
 - self-induction
 - henries
 - CEMF
 - mutual induction

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

5. Describe the generation of alternating current.
 - i. direction of induced voltage
 - ii. left-hand generator rule
 - iii. alternation/revolution
 - iv. cycle
 - v. sine wave/plotting
 - vi. electrical and mechanical degrees

6. Define different values and terms of alternating current.
 - i. alternating current values
 - instantaneous values
 - maximum (peak) values
 - peak to peak values
 - effective (RMS) values
 - average values
 - ii. terminology of alternating current circuits
 - frequency / hertz
 - period
 - phase (in phase, lagging, leading)

7. Describe the characteristics of components found in AC circuits.
 - i. resistance in an AC circuit
 - ii. inductance in an AC circuit
 - iii. capacitance in an AC circuit
 - iv. impedance in an AC circuit
 - trigonometric functions
 - impedance vector
 - v. AC power and power factor correction in an AC circuit
 - power factor introduction
 - pure resistive circuit
 - pure inductive circuit
 - pure capacitive circuit
 - resistive-reactive circuit
 - apparent power and reactive power
 - power factor correction

8. Solve RL, RC, and RLC AC series and AC parallel circuits.
 - i. circuits with resistance and inductive reactance
 - ii. circuits with resistance capacitive reactance
 - iii. circuits with resistance, inductive reactance and capacitive reactance
 - iv. power factor calculation

Practical Requirements:

1. Determine the properties of an AC circuit.
2. Connect AC series and AC parallel circuits containing RLC components.
3. Determine absolute values in AC series and AC parallel circuits containing RLC components.
4. Calculate power and power factor in AC circuits.
5. Use electrical instruments to troubleshoot series and parallel AC circuits.

ER1231 Conductors and Cables

Learning Outcomes:

- Demonstrate knowledge of conductors and cables and their associated components.
- Demonstrate knowledge of the procedures used to install conductors and cables.
- Demonstrate knowledge of the procedures used to terminate conductors.

Duration: 30 Hours

Pre-Requisite(s): ER1411, ER1161

Objectives and Content:

1. Define terminology associated with conductors and cables.
 - i. CSA designations
 - ii. voltage ratings
 - iii. number and size range of conductors
 - iv. number of strands
 - v. conditions of use
 - vi. allowable ampacity
 - vii. temperature ratings
2. Identify hazards and describe safe work practices pertaining to conductors and cables.
3. Identify tools and equipment relating to conductors and cables and describe their applications and procedures for use.

4. Interpret codes and regulations pertaining to conductors and cables.
 - i. Canadian Electrical Code (CEC)
 - applications
 - CSA designations
 - voltage ratings
 - number and size range of conductors
 - construction
 - conditions of use
 - allowable ampacity
 - temperature ratings
 - installation
 - terminations
5. Interpret information pertaining to conductors and cables found on drawings and specifications.
6. Identify types of conductors and cables and describe their characteristics and applications.
7. Identify conductor and cable components and accessories and describe their characteristics and applications.
8. Identify methods of conductor protection and describe their characteristics and applications.
 - i. mechanical
 - ii. electrical
9. Identify the considerations and requirements for selecting conductors and cables and their associated components and accessories.
10. Describe the procedures used to install conductors and cables and their associated components and accessories.
11. Describe the procedures used to terminate conductors.

Practical Requirements:

1. Prepare and install conductors in raceways as per CEC requirements.
2. Set reels on jacks and stands.
3. Select and terminate cables.
 - i. MI
 - ii. Armoured
 - iii. TECK
 - iv. Aluminum sheathed
 - v. NMD
4. Determine size of device and junction boxes.

ER1570 Grounding and Bonding

Learning Outcomes:

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

Duration: 6 Hours

Pre-Requisite(s): ER1161

Objectives and Content:

1. Define terminology associated with grounding and bonding.
2. Identify hazards and describe safe work practices pertaining to grounding and bonding.
3. Interpret codes and regulations pertaining to grounding and bonding.
4. Interpret information pertaining to grounding and bonding found on drawings and specifications.
5. Identify tools and equipment relating to grounding and bonding and describe their applications and procedures for use.
6. Identify methods of grounding and bonding.
 - i. exothermic system
 - ii. crimp

7. Explain, via instructor demonstration, how to prepare and install an exothermic system, using both electronic and manual ignition systems for the following:
 - i. tees
 - ii. copper to ground rod weld
 - iii. copper to steel weld

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

9. Identify the considerations and requirements for selecting grounding and bonding conductors, methods, equipment and components.

10. Describe the procedures used to install grounding and bonding systems.

11. Explain, via instructor demonstration, how to prepare and install a compression system for the following:
 - i. tees
 - ii. copper to ground rod
 - iii. copper to steel
 - iv. copper to copper butt splice

Practical Requirements:

None.

ER1221 Conduit, Tubing and Fittings

Learning Outcomes:

- Demonstrate knowledge of conduit, tubing and fittings, their components and accessories.
- Demonstrate knowledge of the procedures used to select, cut, bend and install conduit, tubing and fittings.

Duration: 30 Hours

Pre-Requisite(s): ER1161

Objectives and Content:

1. Define terminology associated with conduit, tubing and fittings.
2. Identify hazards and describe safe work practices pertaining to conduit, tubing and fittings.
3. Interpret codes and regulations pertaining to conduit, tubing and fittings.
4. Interpret information pertaining to conduit, tubing and fittings found on drawings and specifications.
5. Identify tools and equipment related to conduit, tubing and fittings and describe their applications and procedures for use.
6. Identify types of conduit and tubing and describe their characteristics, applications and limitations.

7. Identify conduit and tubing components and accessories and describe their characteristics and applications.
 - i. fittings
 - ii. couplings
 - iii. connectors
 - iv. boxes
 - v. supports
8. Identify the considerations and requirements for selecting conduit and tubing and their associated components and accessories.
9. Describe the procedures used to cut 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.

Practical Requirements:

1. Apply proper cutting, coupling and termination methods used with conduit.
2. Install rigid metal conduit.
3. Prepare and bend EMT.
4. Install EMT.
5. Prepare and install PVC conduit.
6. Determine the size requirements of pull boxes and junction boxes.

ER2001 Raceways, Wireways and Busways

Learning Outcomes:

- Demonstrate knowledge of raceways, wireways and busways, their components and accessories.
- Demonstrate knowledge of the procedures used to select, install and support raceways, wireways and busways.
- Demonstrate knowledge of the procedures used to install cables and conductors in cable tray.

Duration: 30 Hours

Pre-Requisite(s): ER1411, ER1161

Objectives and Content:

1. Define terminology associated with raceways, wireways and busways.
2. Identify hazards and describe safe work practices pertaining to raceways, wireways and busways.
3. Interpret codes and regulations pertaining to raceways, wireways and busways.
4. Interpret information pertaining to raceways, wireways and busways found on drawings and specifications.
5. Identify tools and equipment relating to raceways, wireways and busways and describe their applications and procedures for use.
6. Identify types of raceways, wireways and busways and describe their characteristics and applications.
7. Identify raceway, wireway and busway components and accessories and describe their characteristics and applications.

8. Identify considerations and requirements for selecting raceways, wireways and busways and their components and accessories.
9. Describe the procedures used to install raceways, wireways and busways, their components and accessories.
10. Identify types of cable tray and describe their characteristics and applications.
11. Identify cable tray components and accessories and describe their characteristics and applications.
12. Identify the considerations and requirements for selecting cable tray and its components and accessories.
13. Describe the procedures used to install and support cable tray.
14. Describe the procedures used to install and secure cables and conductors in cable tray.

Practical Requirements:

1. Install data track.
2. Install cable tray and wireways.

ER1242 Fundamental Wiring

Learning Outcomes:

- Demonstrate knowledge of basic wiring applications and their associated devices and components.
- Demonstrate knowledge of the procedures used to install basic wiring devices and components.

Duration: 60 Hours

Pre-Requisite(s): ER1411, ER1161

Objectives and Content:

1. Define terminology associated with basic wiring.
2. Identify hazards and describe safe work practices pertaining to basic wiring.
3. Interpret codes and regulations pertaining to basic wiring.
4. Interpret information pertaining to basic wiring found on drawings and specifications.
5. Identify tools and equipment related to basic wiring applications and describe their applications and procedures for use.
6. Identify types of basic wiring applications.
 - i. lights and switches
 - ii. receptacles
 - iii. exhaust fans
 - iv. water pumps and water heaters
 - v. heaters and controls

- vi. extra low voltage wiring
 - doorbell
 - lighting
 - vii. din rail
 - terminal blocks
 - relay block
 - fuse block
 - jumpers
 - overload relays
7. Identify types of cables used in basic wiring applications and describe their characteristics.
 - i. non-metallic sheathed cables
 - ii. armored cables
 8. Describe the procedures used to cut, strip and terminate wires used in basic wiring applications.
 9. Describe the procedures used to fish and install cables used in basic wiring applications.
 10. Describe the procedures used to provide mechanical protection and support for cables used in basic wiring applications.
 11. Identify types of devices used in basic wiring applications and describe their characteristics.
 - i. lampholders
 - ii. switches
 - iii. receptacles
 12. Describe the procedures used to install devices used in basic wiring applications.

13. Identify types of boxes used in basic wiring applications and describe their characteristics.
 - i. outlet
 - ii. junction
 - iii. pull

14. Describe the procedures used to select and install boxes used in basic wiring applications.

Practical Requirements:

1. Determine the branch circuit requirements according to the CEC.
2. Determine lighting and switching requirements according to the CEC.
3. Space, locate and install outlets according to CEC.
4. Locate and determine the circuit requirements and install specific-use outlets according to the CEC.
5. Install din rail (low-voltage wiring).
6. Install a door bell/door chime system.

ER2011 Lighting Systems and Controls

Learning Outcomes:

- Demonstrate knowledge of lighting systems and controls, their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot, maintain, repair and test lighting systems and controls.
- Demonstrate knowledge of the procedures used to store and dispose of fluorescent lighting ballasts, capacitors and lamps.

Duration: 25 Hours

Pre-Requisite(s): ER1242

Objectives and Content:

1. Define terminology associated with lighting systems and controls.
 - i. LED
 - ii. HID
 - iii. incandescent
 - iv. florescent
2. Identify hazards and describe safe work practices pertaining to lighting systems and controls.
3. Interpret codes and regulations pertaining to lighting systems and controls.
4. Interpret information pertaining to lighting systems and controls found on drawings and specifications.
5. Identify tools and equipment relating to lighting systems and controls and describe their applications and procedures for use.

6. Identify types of lighting systems and describe their characteristics and applications.
7. Identify lighting system components and accessories and describe their characteristics and applications.
8. Identify types of lighting system controls and describe their characteristics and applications.
 - i. extra low voltage
 - ii. low voltage
9. Identify lighting system control components and accessories and describe their characteristics and applications.
10. Identify considerations and requirements for selecting lighting systems, their controls, components and accessories.
11. Describe the procedures used to install and connect lighting systems, their controls, components and accessories.
12. Describe the procedures used to troubleshoot lighting systems, their controls, components and accessories.
13. Describe the procedures used to maintain, repair and test lighting systems, their controls, components and accessories.
 - i. wireless
 - ii. occupancy sensors
 - iii. dimming systems
14. Identify the hazards associated with the storage and disposal of fluorescent lighting system ballasts, capacitors and lamps.
15. Describe the procedures used to store and dispose of fluorescent lighting system ballasts, capacitors and lamps.

Practical Requirements:

1. Install incandescent lighting according to CEC requirements in a specified location.
2. Install fluorescent lighting systems according to CEC requirements in a specified location.
3. Install LED lighting system complete with remote drivers according to CEC requirements in a specified location.
4. Connect an HID fixture complete with a multi-tap ballast.
5. Troubleshoot problems with fluorescent lighting systems.

ER1190 Three-Phase Theory

Learning Outcomes:

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

Duration: 30 Hours

Pre-Requisite(s): ER1180

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to three-phase electricity.
2. Describe the generation of three-phase voltages.
 - i. characteristics of three-phase
 - ii. phase sequence
3. Describe the voltage and current values in three-phase wye connections.
 - i. voltage and current relationships in a wye connection
 - ii. current relationships in a wye connection
 - iii. ground connections
 - iv. 3-wire wye connections
 - v. 4-wire wye connections
 - vi. phase loss calculations
4. Describe the voltage and current values in three-phase delta connections.
 - i. cautions regarding improper delta connections
 - ii. voltage relationships in a delta connection
 - iii. current relationships in a delta connection
 - iv. open delta connections
 - v. 3-wire delta connections
 - vi. 4-wire delta connections
 - vii. comparing wye and delta systems

5. Perform calculations for balanced and unbalanced loads.
6. Describe the procedures used to calculate three-phase power, volt-amperes, reactive power and power factor.
 - i. three-phase apparent power
 - ii. three-phase power
 - iii. power factor
 - iv. measurements for three-phase power
7. Describe the procedures used to measure three-phase power using watt meters.
 - i. two watt meter method
 - ii. three watt meter method
 - iii. polyphase watt meter

Practical Requirements:

1. Calculate three-phase power, volt-amperes, reactive power, and power factor.
2. Connect three-phase circuits and measure three-phase power using watt-meters.

ER1170 Voltage Drop and Power Loss

Learning Outcomes:

- Demonstrate knowledge of voltage drop and power loss and its impact on a circuit.

Duration: 30 Hours

Pre-Requisite(s): ER1190

Objectives and Content:

1. Identify the types of conductor materials and describe their characteristics.
 - i. aluminum
 - ii. copper
2. Identify types of insulators and describe their characteristics and applications.
3. Explain conductor resistance and its effects on a circuit.
 - i. resistivity
 - ii. cross-sectional area
 - iii. length
 - iv. temperature coefficient of resistance
4. Describe the procedures used to determine conductor resistance.
5. Explain line voltage drop and its effects on a circuit.
 - i. factor affecting voltage drop
 - ii. calculate voltage drop
 - iii. CEC requirements
 - iv. voltage drop percentage
6. Explain power loss and its effects on a circuit.
 - i. calculate power loss

7. Describe the operation of a three-wire system.
 - i. purpose of a three-wire system
 - ii. neutral wire

Practical Requirements:

1. Use CEC tables to calculate voltage drop.
2. Calculate the absolute values in three-wire circuits.

ER1271 Single-Phase Service Entrance

Learning Outcomes:

- Demonstrate knowledge of single-phase service entrances, their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot, maintain, repair and test single-phase service entrances.
- Demonstrate knowledge of demand factor calculations.

Duration: 30 Hours

Pre-Requisite(s): ER1242

Objectives and Content:

1. Define terminology associated with single-phase service entrances.
2. Identify hazards and describe safe work practices pertaining to single-phase service entrances.
3. Interpret codes and regulations pertaining to single-phase service entrances.
4. Interpret information pertaining to single-phase service entrances found on drawings and specifications.
5. Identify sources of information and documentation required for the installation of single-phase service entrances.
6. Identify tools and equipment relating to single-phase service entrances and describe their applications and procedures for use.

7. Identify types of single-phase service entrances and describe their characteristics and applications.
 - i. temporary service
 - ii. overhead
 - iii. underground
 - iv. multiple metering
8. Identify single-phase service entrance components and accessories and describe their characteristics and applications.
9. Identify the considerations and requirements for selecting the type of single-phase service entrances, their components and accessories.
10. Describe the procedures used to calculate demand factor.
11. Describe the procedures used to install and connect single-phase service entrances, their components and accessories.
12. Identify the methods of grounding and bonding single-phase service entrances and describe their associated procedures.
13. Describe the procedures to troubleshoot single-phase service entrances, their components and accessories.
14. Describe the procedures used to maintain, repair and test single-phase service entrances, their components and accessories.

Practical Requirements:

1. Determine service layout and equipment/materials required.
2. Install a single-phase, three wire distribution system.
3. Install single-phase service entrance equipment.
4. Install grounding and bonding electrodes and conductors.

ER1371 Distribution Equipment

Learning Outcomes:

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

Duration: 17 Hours

Pre-Requisite(s): ER1190

Objectives and Content:

1. Define terminology associated with distribution equipment.
2. Identify hazards and describe safe work practices pertaining to distribution equipment.
3. Interpret codes and regulations pertaining to distribution equipment.
4. Interpret information pertaining to distribution equipment found on drawings and specifications.
5. Identify tools and equipment relating to distribution equipment and describe their applications and procedures for use.
6. Identify types of distribution equipment and describe their characteristics and applications.
 - i. enclosures
 - ii. disconnect switches and switchgear
 - iii. panel boards
 - iv. low-voltage switchboards
 - v. motor control centers

7. Identify distribution equipment components and accessories and describe their characteristics and applications.
8. Identify the considerations and requirements for selecting distribution equipment, its components and accessories.
9. Describe the procedures used to install and connect distribution equipment, its components and accessories.
10. Describe the procedures used to troubleshoot distribution equipment, its components and accessories.
11. Describe the procedures used to maintain, repair and test distribution equipment, its components and accessories.

Practical Requirements:

None.

ER1250 Protective Devices

Learning Outcomes:

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

Duration: 30 Hours

Pre-Requisite(s): ER1190

Objectives and Content:

1. Describe the function of protective devices.
 - i. overcurrent
 - ii. overload
 - iii. short circuit
 - iv. maximum interrupting capacity
2. Identify hazards and describe safe work practices pertaining to protective devices.
3. Describe the effects of short-circuit current.
 - i. fault currents
 - ii. percent impedance
 - iii. types of damage
4. Describe overcurrent devices, their characteristics and applications
 - i. voltage
 - ii. current
 - iii. interrupting capacity
 - iv. time-current characteristics

5. Identify types of fuses and disconnects, and describe their characteristics and applications.
 - i. screw-base plug fuses
 - ii. standard cartridge fuses
 - iii. renewable link fuses
 - iv. high rupture capacity fuses
 - v. time delay fuses
 - vi. classifications of fuses

6. Identify types of low-voltage circuit breakers and describe their characteristics and applications.
 - i. thermal trip action
 - ii. magnetic trip action
 - iii. moulded case
 - iv. high interrupting capacity type
 - v. ground fault interrupters
 - vi. arc fault circuit interrupters
 - vii. surge suppression

7. Identify the CEC requirements for the selection of protective devices.

8. Describe the coordination of protective devices.
 - i. manufacturer's chart
 - ii. engineer's responsibilities
 - iii. electrician's responsibilities

9. Describe the procedures used to troubleshoot and maintain protective devices.

Practical Requirements:

1. Select fuses/breakers according to specific requirements and CEC requirements.
2. Determine interrupting capacity requirements of fuses/breakers.

ER2022 Single-Phase Motors

Learning Outcomes:

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

Duration: 30 Hours

Pre-Requisite(s): ER1180

Objectives and Content:

1. Define terminology associated with single-phase motors.
2. Identify hazards and describe safe work practices pertaining to single-phase motors.
3. Interpret codes and regulations pertaining to single-phase motors.
4. Interpret information pertaining to single-phase motors found on drawings and specifications.
5. Identify tools and equipment relating to single-phase motors and describe their applications and procedures for use.
6. Explain the construction and operating principles of single-phase motors.
7. Interpret information contained on motor nameplates.
8. Identify types of single-phase motors and describe their characteristics and applications.

9. Identify single-phase motor components and accessories and describe their characteristics and applications.
10. Identify coupling methods for single-phase motors and describe their characteristics and applications.
11. Identify the considerations and requirements for selecting single-phase motors, their components and accessories.
12. Describe the procedures used to install and connect single-phase motors, their components and accessories.
13. Describe the procedures used to troubleshoot single-phase motors, their components and accessories.
14. Describe the procedures used to maintain, repair and test single-phase motors, their components and accessories.

Practical Requirements:

1. Connect and operate single phase motors using the following:
 - i. overload protection
 - ii. one-time fuse
 - iii. time-delay fuse
 - iv. circuit breakers
2. Troubleshoot single phase motors.
3. Conduct operational tests pertaining to single-phase AC motors.

ER1580 Job Planning

Learning Outcomes:

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

Duration: 6 Hours

Pre-Requisite(s): ER1411, ER1161, ER1212

Objectives and Content:

1. Identify sources of information relevant to planning job tasks.
 - i. documentation
 - ii. drawings
 - iii. related professionals
 - iv. clients

2. Describe the considerations to plan and organize job tasks.
 - i. permits
 - ii. hazard assessment
 - iii. personnel
 - iv. tools and equipment
 - v. materials and supplies
 - vi. scheduling/sequencing

Practical Requirements:

1. Complete a hazard assessment form.

ER1281 Three-Phase Service Entrance

Learning Outcomes:

- Demonstrate knowledge of three-phase service entrances, their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot, maintain, repair and test three-phase service entrances.
- Demonstrate knowledge of three-phase service entrance related calculations.

Duration: 30 Hours

Pre-Requisite(s): ER1271, ER1190

Objectives and Content:

1. Define terminology associated with three-phase service entrances.
2. Identify hazards and describe safe work practices pertaining to three-phase service entrances.
3. Interpret codes and regulations pertaining to three-phase service entrances.
4. Interpret information pertaining to three-phase service entrances found on drawings and specifications.
5. Identify sources of information and documentation required for the installation of three-phase service entrances.
6. Identify tools and equipment relating to three-phase service entrances and describe their applications and procedures for use.
7. Identify types of three-phase service entrances and describe their characteristics and applications.

8. Identify three-phase service entrance components and accessories and describe their characteristics and applications.
 - i. distribution panel
 - ii. splitters and splitter troughs
 - iii. metering equipment
 - iv. conductors
 - v. grounding and bonding
9. Identify the considerations and requirements for selecting three-phase service entrances, their components and accessories.
10. Describe the procedures used to install and connect three-phase underground service entrances, their components and accessories.
11. Identify the requirements and describe the procedures for conductor installation and termination.
12. Describe the procedures used to troubleshoot three-phase service entrances, their components and accessories.
13. Describe the procedures used to maintain, repair and test three-phase service entrances, their components and accessories.
14. Perform calculations relating to three-phase service entrances.

Practical Requirements:

1. Install a 400A three-phase service complete with the following:
 - i. CTs
 - ii. splitters
 - iii. panels
 - iv. grounding/bonding

ER2351 Electric Surface Heating Systems

Learning Outcomes:

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

Duration: 15 Hours

Pre-Requisite(s): ER1242, ER1161

Objectives and Content:

1. Define terminology associated with electric surface heating systems.
2. Identify hazards and describe safe work practices pertaining to electric surface heating systems.
3. Interpret codes and regulations pertaining to electric surface heating systems.
4. Interpret information pertaining to electric surface heating systems found on drawings and specifications.
5. Identify tools and equipment relating to electric surface heating systems and describe their applications and procedures for use.
6. Identify types of electric surface heating systems and describe their characteristics and applications.
 - i. cables
 - ii. panels
 - iii. heat tracing
 - iv. immersion heaters

7. Identify electric heating surface unit controls, components and accessories and describe their characteristics and applications.
8. Identify the considerations and requirements for selecting electric surface heating systems, their controls, components and accessories.
9. Describe the procedures used to install and connect electric surface heating systems, their controls, components and accessories.
10. Describe the procedures used to troubleshoot electric surface heating systems, their controls, components and accessories.
11. Describe the procedures used to maintain, repair and test electric surface heating systems, their controls, components and accessories.
 - i. types of electric heaters
 - ii. procedures used to install electric heaters
 - iii. procedures used to control electric heaters
 - iv. requirements used to perform a heatless calculation

Practical Requirements:

None.

ER1262 Transformers

Learning Outcomes:

- Demonstrate knowledge of transformers, their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot and maintain transformers.

Duration: 60 Hours

Pre-Requisite(s): ER1190

Objectives and Content:

1. Define terminology associated with transformers.
2. Identify hazards and describe safe work practices pertaining to transformers.
3. Interpret codes and regulations pertaining to transformers.
4. Interpret information pertaining to transformers found on drawings and specifications.
5. Identify tools and equipment relating to transformers and describe their applications and procedures for use.
6. Explain the operating principles of transformers.
7. Interpret information contained on transformer nameplates.
8. Identify types and classes of transformers and describe their characteristics, applications.
 - i. high-voltage
 - ii. low-voltage
 - iii. special

9. Identify applications for special transformers.
 - i. instrument
 - ii. auto transformer
 - iii. ignition
 - iv. isolation
 - v. buck and boost
 - vi. multi-tap
 - vii. zig zag
 - viii. scott/tee
10. Identify transformer components and accessories and describe their characteristics and applications.
11. Explain transformer polarity and terminal markings.
12. Explain the operation of primary and secondary connections for single-phase transformers.
13. Explain the operation of primary and secondary connections for three-phase transformers.
 - i. wye to wye
 - ii. wye to delta
 - iii. delta to wye
 - iv. delta to delta
 - v. three-phase four-wire delta
 - vi. open delta
14. Identify the considerations and requirements for selecting transformers, their components and accessories.
15. Describe the procedures used to install and connect transformers, their components and accessories.
16. Describe the procedures used to install transformers in parallel.

17. Describe the procedures used to troubleshoot transformers, their components and accessories.
18. Describe the procedures used to maintain and test transformers, their connections, components and accessories.
19. Perform transformer related calculations.
 - i. turns/voltage/current ratios
 - ii. voltage, current and kVA
 - iii. fault current
20. Use schematic diagrams to illustrate transformer connections.

Practical Requirements:

1. Perform polarity tests.
2. Measure transformer voltage/current ratios.
3. Measure and calculate three-phase voltage and current.
4. Connect three-phase transformers and verify connections and voltage.
5. Conduct operational tests pertaining to transformers.
6. Perform transformer related calculations.
 - i. turns/voltage/current ratios
 - ii. voltage, current and kVA calculations

ER2391 Fiber Optics

Learning Outcomes:

- Demonstrate knowledge of fiber optics, their applications and operation.
- Demonstrate knowledge of the procedures used to install, and connect, troubleshoot, maintain, repair and test fiber optic cables.

Duration: 18 Hours

Pre-Requisite(s): ER1242

Objectives and Content:

1. Define terminology associated with fiber optics.
2. Identify hazards and describe safe work practices pertaining to fiber optics.
3. Interpret codes and regulations pertaining to fiber optics.
4. Interpret information pertaining to fiber optics found on drawings and specifications.
5. Identify tools and equipment relating to fiber optics and describe their applications and procedures for use.
6. Explain the propagation of light through the optical fiber.
7. Identify types of fiber optics systems and describe their characteristics and applications.
8. Identify fiber optic system components and describe their characteristics and applications.
 - i. sources
 - ii. detectors
 - iii. transmitters and receivers

9. Identify types of fiber optic cables and describe their characteristics and applications.
 - i. indoor
 - ii. outdoor
 - iii. hybrid
10. Identify fiber optic cable components and accessories and describe their characteristics and applications.
11. Identify the considerations and requirements for selecting fiber optic systems and cables, their components and accessories.
12. Describe the procedures used to install and connect fiber optic systems and cables, their components and accessories.
 - i. bending radius
 - ii. pulling tension
 - iii. lubrication
 - iv. terminating and splicing
13. Describe the procedures used to troubleshoot fiber optic systems and cables, their components and accessories.
14. Describe the procedures used to maintain, repair and test fiber optic systems and cables, their components and accessories.

Practical Requirements:

None.

ER1341 Fire Alarms

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.

Duration: 20 Hours

Pre-Requisite(s): ER2391

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to fire alarm systems.
2. Define terminology associated with 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 (pull stations and detectors)
 - ii. signaling devices (audible and visual)
 - iii. control panel
 - iv. ancillary devices
 - communications system wiring
 - emergency visual/audio control systems
 - fire alarm/extinguishing systems
 - electromagnetic door release devices
 - fire alarm accessories

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.
 - i. manufacturer's wire types/size requirements
 - ii. end-of-line resistors selection chart
 - iii. component connections
 - iv. control panel connections
 - v. typical test procedures

10. Describe the procedures used to verify a fire alarm system and troubleshoot problems.
 - i. system check
 - ii. systems verification

Practical Requirements:

1. Install, test, and troubleshoot a fire alarm system.
2. Conduct operational tests pertaining to fire alarms.

ER2142 Security 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.

Duration: 10 Hours

Pre-Requisite(s): ER2391

Objectives and Content:

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.

Practical Requirements:

None.

ER2134 Communication 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.

Duration: 20 Hours

Pre-Requisite(s): ER2391

Objectives and Content:

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.
13. Describe the procedures used to install, configure, and maintain networking systems.
 - i. explain general types of network topologies used in industry.
 - bus
 - ring
 - star
 - ii. explain the use of addressing with different network topologies
 - iii. identify and explain the operation of networking components.
 - modems
 - routers
 - switches
 - structured cabling
 - racks
 - punch blocks
 - cross-connects
 - gateways

- iv. specialty tools such as punch downs, crimp tools
- v. identify and describe cables used for industrial networks
- vi. identify and explain the codes and standards for installation and maintenance of industrial networks
- vii. identify and explain the operation of network testing devices
 - wire mappers
 - multi-meters
 - network analyzers (OTDR)
- viii. describe the methods used for converting from one network protocol to another.

Practical Requirements:

None.

ER1590 Introduction to Communication and Trade Documentation

Learning Outcomes:

- Demonstrate knowledge of effective communication practices.
- Demonstrate knowledge of trade related documentation and its use.

Duration: 6 Hours

Pre-Requisite(s): ER1580

Objectives and Content:

1. Describe the importance of effective verbal and non-verbal communication.
 - i. other tradespersons
 - ii. colleagues
 - iii. supervisors
 - iv. suppliers/manufacturers

2. Identify types of trade related documentation and describe their purpose, applications and procedures for use.
 - i. manufacturers' specifications
 - ii. codes and standards (CSA)
 - Canadian Electrical Code
 - National Building Code
 - ISA
 - iii. work orders / work packs
 - iv. maintenance schedules
 - preventative maintenance
 - predictive maintenance
 - v. calibration/maintenance records

Practical Requirements:

1. Complete a work order.

AM1100 Math Essentials

Note: It is recommended that AM1100 be delivered in the first semester of the Entry Level training program.

Learning Outcomes:

- Demonstrate knowledge of the numeracy skills required to begin the 2nd level math course.
- Demonstrate knowledge of mathematics as a critical element of the trade environment.
- Demonstrate knowledge of mathematical principles in trade problem solving situations.
- Demonstrate the ability to solve simple mathematical word problems.

Duration: 30 Hours

Pre-Requisite(s): None

Objectives and Content:

Wherever possible, the instructor should use trade specific examples to reinforce the course objectives

1. Use multiplication tables from memory.
2. Perform whole number operations.
 - i. read, write, count, round off, add, subtract, multiply and divide whole numbers
3. Apply the order of operations in math problems.
4. Perform fraction and mixed number operations.
 - i. read, write, add, subtract, multiply and divide fractions

5. Perform decimal operations.
 - i. read, write, round off, add, subtract, multiply and divide decimals
6. Perform percent/decimal/fraction conversion and comparison.
 - i. convert between fractions, decimals and percents
7. Perform percentage operations.
 - i. read and write percentages
 - ii. calculate base, rates and percentages
8. Perform ratio and proportion operations.
 - i. use a ratio comparing two quantities with the same units
 - ii. use a proportion comparing two ratios
9. Use the imperial measurement system in math problems.
 - i. identify units of measurement for:
 - length
 - mass
 - area
 - volume
 - capacity
10. Use the metric measurement system in math problems.
 - i. identify units of measurement for:
 - length
 - mass
 - area
 - volume
 - capacity

Practical Requirements:

1. To emphasize or further develop specific knowledge objectives, students will be asked to complete practical demonstrations which confirm proper application of mathematical theory to job skills.

AM1160 Electrician Math Fundamentals

Learning Outcomes:

- Demonstrate knowledge of mathematical concepts in the performance of trade practices.
- Demonstrate knowledge of mathematics as a critical element of the trade environment.
- Demonstrate knowledge of solving mathematical word problems.
- Demonstrate knowledge of mathematical principles for the purposes of problem solving, job and materials estimation, measurement, calculation, system conversion, diagram interpretation and scale conversions, formulae calculations, and geometric applications.

Duration: 30 Hours

Pre-Requisite(s): AM1100

Objectives and Content:

The instructor is required to use trade specific examples to reinforce the course objectives.

1. Employ percent/decimal/fraction conversion and comparison in trade specific situations.
2. Apply ratios and proportions to trade specific problems.
3. Use the Imperial Measurement system in trade specific applications.
4. Use the Metric Measurement system in trade specific applications.
5. Complete Imperial/Metric conversions in trade specific situations.
 - i. convert between imperial and metric measurements
 - ii. convert to another unit within the same measurement system

6. Manipulate formulas using cross multiplication, dividing throughout, elimination, and substitution to solve trade specific problems, such as:
 - i. right angle triangles
 - ii. area
 - iii. volume
 - iv. perimeter

7. Perform calculations involving geometry that are relevant to the trade, such as:
 - i. angle calculations
 - ii. circle calculations

8. Use practical math skills to complete administrative trade tasks.
 - i. material estimation
 - ii. material costing
 - iii. time & labour estimates
 - iv. taxes & surcharges
 - v. markup & projecting revenue

Practical Requirements:

1. To emphasize or further develop specific knowledge objectives, students will be asked to complete practical demonstrations which confirm proper application of mathematical theory to job skills.

Note:

This course has been designated as NON-TRANSFERABLE to other trades programs, and NOT ELIGIBLE FOR PRIOR LEARNING ASSESSMENT. Students completing training in this trade program are required to complete this math course.

CM2160 Communication Essentials

Learning Outcomes:

- Demonstrate knowledge of the importance of well-developed writing skills in the workplace and in career development.
- Demonstrate knowledge of the purpose of various types of workplace correspondence.
- Demonstrate knowledge of the principles of effective workplace writing.
- Demonstrate knowledge of standard formats for letters and memos.
- Demonstrate knowledge of principles related to writing effective letters and memos.
- Demonstrate the ability to prepare and deliver an oral presentation.
- Demonstrate knowledge of the importance of effective interpersonal skills in the workplace.

Duration: 45 Hours

Pre-Requisite(s): None

Objectives and Content:

Wherever possible, the instructor is expected to use trade specific examples to reinforce the course objectives.

1. Identify the principles for writing clear, concise, complete sentences and paragraphs which adhere to the conventions of grammar, punctuation, and mechanics.
2. Identify the principles of effective workplace writing.
 - i. describe the value of well-developed writing skills to career success
 - ii. discuss the importance of tone, and language or word choice in workplace communication, regardless of the circumstances
 - iii. demonstrate an awareness of cultural differences when preparing workplace correspondence

- iv. describe the writing process as it applies to workplace communication
 - planning
 - writing
 - editing/revising
 - v. identify the parts of a business letter and memo, and when each should be used in the workplace
 - vi. identify the standard formats for business letters and memos
 - vii. identify guidelines for writing sample letters and memos which convey:
 - acknowledgment
 - routine request
 - routine response
 - complaint
 - refusal
 - persuasive request
 - letters of appeal
3. Identify types of informal workplace documents.
- i. identify types & purposes of reports
 - incident
 - process
 - progress
 - ii. identify common trade specific forms
 - iii. describe primary and secondary methods used to gather information
 - iv. discuss the importance of accuracy and completeness in reports and forms
4. Identify the elements of presentations used in the workplace.
- i. identify presentation types
 - impromptu
 - informative
 - demonstration
 - persuasive
 - ii. identify the components of an effective presentation
 - eye contact
 - body language
 - vocal qualities
 - audience analysis
 - multimedia tools
 - keeping on topic

5. Demonstrate an understanding of interpersonal communications in the workplace.
 - i. identify listening techniques
 - ii. demonstrate an understanding of group dynamics
 - iii. describe the importance of contributing information and expertise in the workplace
 - iv. describe the importance of respectful and open communication in the workplace
 - v. identify methods to accept and provide feedback in a constructive and considerate manner
 - vi. explain the role of conflict in a group to reach solutions

6. Identify acceptable workplace uses of communication technologies.
 - i. cell / Smart Phone etiquette
 - ii. voice mail
 - iii. e-mail
 - iv. teleconferencing / videoconferencing for meetings and interviews
 - v. social networking
 - vi. other emerging technologies

Practical Requirements:

1. Write well-developed, coherent, unified paragraphs.
2. Write sample letters and memos.
3. Write one short informal report.
4. Complete a selection of at least 3 trade-related forms.
5. Deliver an effective oral presentation.

SD1760 Workplace Essentials

Note: It is recommended that SD1760 be delivered in the second half of the Entry Level training program.

Learning Outcomes:

- Demonstrate knowledge of workplace essentials in the areas of meetings, unions, workers compensation, workers' rights, and human rights.
- Demonstrate knowledge of good customer service practices.
- Demonstrate knowledge of effective job search techniques.

Duration: 45 Hours

Pre-Requisite(s): None

Objectives and Content:

Wherever possible, the instructor is expected to use trade specific examples to reinforce the course objectives.

1. Identify common practices related to workplace meetings.
 - i. identify and discuss meeting format and preparation required for a meeting
 - ii. explain the purpose of an agenda
 - iii. explain the expected roles, responsibilities, and etiquette of meeting participants
2. Define unions and identify their role in the workplace.
 - i. identify the purpose of unions
 - ii. identify a common union structure
 - iii. identify the function of unions in this trade
3. Demonstrate an understanding of the Worker's Compensation process.
 - i. describe the aims, objectives, regulations and benefits of the Workplace Health, Safety and Compensation Commission
 - ii. explain the role of the Workers Advisor
 - iii. explain the internal review process

4. Demonstrate an understanding of workers' rights.
 - i. define labour standards
 - ii. identify regulations, including:
 - hours of work & overtime
 - termination of employment
 - minimum wages & allowable deductions
 - statutory holidays, vacation time, and vacation pay

5. Demonstrate an understanding of Human Rights issues.
 - i. examine the Human Rights Code and explain the role of the Human Rights Commission
 - ii. define harassment in various forms and identify strategies for prevention
 - direct
 - systemic
 - adverse effect
 - iii. identify gender and stereotyping issues in the workplace
 - iv. define basic concepts and terms related to workplace diversity including age, race, culture, religion, socio-economic status, and sexual orientation

6. Demonstrate an understanding of quality customer service.
 - i. explain why quality service is important
 - ii. identify barriers to quality customer service
 - iii. identify customer needs & common methods for meeting them
 - iv. identify and discuss the characteristics & importance of a positive attitude
 - v. identify the importance of demonstrating good communication skills including body language, listening, questioning, and when using electronic communication devices
 - vi. identify techniques for interacting with challenging customers to address complaints and resolve conflict

7. Demonstrate an understanding of effective job search techniques.
 - i. identify and explain employment trends, opportunities, and sources of employment
 - ii. identify and discuss essential skills for the trades as outlined by Human Resources and Skills Development Canada
 - iii. review job ads and identify the importance of fitting qualifications to job requirements
 - iv. identify the characteristics of effective resumes, the types of resumes, and principles of resume formatting
 - v. identify the characteristics of an effective cover letter
 - vi. identify the components of a portfolio, and discuss the value of establishing and maintaining a personal portfolio
 - vii. identify the common characteristics of the job interview process:
 - pre-interview preparation
 - interview conduct
 - post-interview follow up

Practical Requirements:

1. Create a resume.
2. Create a cover letter.
3. Participate in a mock job interview.

MC1060 Computer Essentials

Learning Outcomes:

- Demonstrate knowledge of computer systems and their operation.
- Demonstrate knowledge of popular software packages and their applications.
- Demonstrate knowledge of security issues related to computers.

Duration: 15 Hours

Pre-Requisite(s): None

Objectives and Content:

Wherever possible, the instructor is expected to use trade specific examples to reinforce the course objectives.

1. Identify the major external components of a microcomputer system.
 - i. input devices
 - ii. output devices
 - iii. central control unit

2. Use operating system software.
 - i. start and quit a program
 - ii. use the help function
 - iii. use the find function
 - iv. maximize and minimize a window
 - v. use the task bar
 - vi. adjust desktop settings such as screen savers, screen resolution, and backgrounds
 - vii. shut down a computer

3. Perform file management commands.
 - i. create folders
 - ii. copy files and folders
 - iii. move files and folders
 - iv. rename files and folders
 - v. delete files and folders

4. Use word processing software to create documents.
 - i. enter text
 - ii. indent and tab text
 - iii. change text attributes (bold, underline, font, etc.)
 - iv. change layout format (margins, alignment, line spacing)
 - v. spell check and proofread
 - vi. edit text
 - vii. save document
 - viii. print document
 - ix. close document
 - x. retrieve documents

5. Use spreadsheet software to create spreadsheets.
 - i. enter data in cells
 - ii. create formulas to add, subtract, multiply and divide
 - iii. save spreadsheet
 - iv. print spreadsheet
 - v. close spreadsheet
 - vi. retrieve spreadsheet

6. Access the Internet.
 - i. access websites using the world wide web(www)
 - ii. identify examples of web browsers
 - iii. use search engines with common searching techniques
 - iv. describe security issues

7. Use electronic mail.
 - i. describe e-mail etiquette
 - grammar and punctuation
 - privacy and legal issues when sharing and forwarding e-mail
 - work appropriate content
 - awareness of employer policies
 - ii. manage e-mail using the inbox, sent, and deleted folders
 - iii. send an e-mail message with attachment(s)
 - iv. print e-mail

Practical Requirements:

None.

AP1101 Introduction to Apprenticeship

Learning Outcomes:

- Demonstrate knowledge of how to become a registered apprentice.
- Demonstrate knowledge of the steps to complete an apprenticeship program.
- Demonstrate knowledge of various stakeholders in the apprenticeship process.
- Demonstrate knowledge of the Red Seal Program.

Duration: 15 Hours

Pre-Requisite(s): None

Objectives and Content:

1. Define the following terms:
 - i. apprenticeship
 - ii. apprentice vs. registered apprentice
 - iii. Journeyperson vs. Certified Journeyperson
 - iv. Certificate of Apprenticeship
 - v. Certificate of Qualification
 - vi. Recognition of Prior Learning
 - vii. dual certification

2. Explain the apprenticeship system in Newfoundland and Labrador and the roles and responsibilities of those involved.
 - i. registered apprentice
 - ii. training institution
 - iii. employer
 - iv. Journeyperson
 - v. Department of Advanced Education and Skills
 - Industrial Training Section
 - Standards and Curriculum Section
 - vi. Provincial Trade Advisory Committees
 - vii. Provincial Apprenticeship and Certification Board

3. Identify the Conditions Governing Apprenticeship.
4. Describe the training and educational requirements.
 - i. pre-employment (entry level) training
 - ii. block release
 - iii. on-the-job
5. Explain the steps in the registered apprenticeship process.
 - i. criteria for eligibility
 - entrance requirements as per Conditions of Apprenticeship
 - employment
 - ii. registration process
 - application requirements
 - iii. Memorandum of Understanding
 - probation period
 - cancellation
 - iv. Record of Occupational Progress (Logbook)
 - signing off skills
 - recording hours
 - updating PDO on progress
 - v. class calls
 - schedule
 - EI Eligibility
 - Direct Entry
 - advanced level
 - vi. Block Exams
 - vii. progression
 - schedule
 - wage rates
 - viii. cancellation of apprenticeship
 - ix. Practical Examinations
 - x. Provincial and Interprovincial examinations
 - xi. certification
 - Certification of Apprenticeship
 - Certification of Qualification
 - Provincial certification
 - Interprovincial Red Seal endorsement

6. Explain the Interprovincial Standards Red Seal Program.
 - i. designated Red Seal trade
 - ii. the National Occupational Analysis (NOA)
 - iii. Interprovincial (IP) Red Seal Endorsement Examination
 - iv. relationship of NOA to IP Examination
 - v. qualification recognition and mobility
7. Identify the current financial incentives available to apprentices.
8. Explain the NL apprenticeship and trades certification division's out-of- province apprenticeship policy.

Practical Requirements:

1. Use the Provincial Apprenticeship and Trades Certification web site at www.gov.nl.ca/app to:
 - i. locate, download, and complete the Application for Apprenticeship and Memorandum of Understanding (MOU)
 - ii. locate, download, and complete the Out of Province registration forms
 - Application for Apprenticeship (out of province)
 - Letter of Understanding (LOU)
 - Acceptance of Conditions Letter
 - iii. locate, download, and complete the Work Experience Credits form
 - iv. identify the locations of all Industrial Training offices
 - v. locate and review the following learning resources relevant to the trade:
 - Study Guide
 - Exam Preparation Guide
 - Plan of Training
2. Use a logbook for this trade to:
 - i. identify the hours for the trade (in-school and on-the-job)
 - ii. identify the number of blocks
 - iii. identify the courses in each block
 - iv. identify the workplace skills to be completed and verified

3. Use the Red Seal Web site, <http://www.red-seal.ca> to retrieve the National Occupational Analyses (NOA) for this trade.
 - i. identify the following components of the NOA:
 - Trends
 - Scope
 - Key Competencies
 - Blocks
 - Tasks
 - Subtasks
 - Pie Charts
 - Table of Specifications

OT1150 Workterm

Learning Outcomes:

- Demonstrate knowledge of theory and practical applications of trade skills, safe work practices, appropriate workplace behaviour, and time management through exposure to the trade in an authentic work environment

NOTE: The pre-apprentice must be supervised at the workplace. Supervision staff must be appropriately qualified to undertake that role – preferably a certified Journey person for the trade.

Duration: 80 Hours

Pre-Requisite(s): None

BLOCK II

ER2042 Discrete Control Devices

Learning Outcomes:

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

Duration: 12 Hours

Pre-Requisite(s): Block I

Objectives and Content:

1. Define terminology associated with discrete control devices.
2. Identify hazards and describe safe work practices pertaining to discrete control devices.
3. Interpret codes and regulations pertaining to discrete control devices.
4. Interpret information pertaining to discrete control devices found on drawings and specifications.
5. Identify tools and equipment relating to discrete control devices and describe their applications and procedures for use.

6. Identify types of discrete control devices and describe their characteristics and applications.
 - i. on-off control
 - ii. counters and totalizers
 - iii. timers
 - iv. relays
 - v. pressure
 - vi. temperature
 - vii. level
 - viii. flow
 - ix. limit
 - x. proximity
 - xi. selector
7. Identify discrete control device components and accessories and describe their characteristics and applications.
8. Identify the considerations and requirements for selecting discrete control devices, their components and accessories.
9. Describe the procedures used to install and connect discrete control devices, their components and accessories.
10. Describe the procedures used to troubleshoot discrete control devices, their components and accessories.
11. Describe the procedures used to maintain, repair and test discrete control devices, their components and accessories.

Practical Requirements:

None.

ER2710 Heating, Ventilation and Cooling Systems

Learning Outcomes:

- Demonstrate knowledge of heating, ventilation and cooling systems, their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot, maintain, repair and test electrical components of heating, ventilation and cooling systems.

Duration: 15 Hours

Pre-Requisite(s): Block I

Objectives and Content:

1. Define terminology associated with heating, ventilation and cooling systems.
2. Identify hazards and describe safe work practices pertaining to heating, ventilation and cooling systems.
3. Interpret codes and regulations pertaining to heating, ventilation and cooling systems.
4. Interpret information pertaining to heating, ventilation and cooling systems found on drawings and specifications.
5. Identify tools and equipment relating to the electrical installation of heating, ventilation and cooling systems and describe their applications and procedures for use.
6. Explain the principles of heat transfer.
 - i. radiation
 - ii. conduction
 - iii. convection

7. Identify types of heating, ventilation and cooling systems and describe their characteristics and applications.
 - i. heating systems
 - radiant heating
 - convection heating
 - central heating
 - ii. ventilation/air exchange
 - iii. cooling
 - refrigeration
 - air conditioning
8. Identify heating, ventilation and cooling system components and accessories and describe their characteristics and applications.
9. Identify the considerations and requirements for selecting heating, ventilation and cooling systems, their components and accessories.
 - i. residential
 - ii. commercial
 - iii. industrial
10. Perform calculations to determine heat loss.
11. Perform calculations to determine heating requirements.
12. Describe the procedures used to install and connect electrical components of heating, ventilation and cooling systems.
13. Describe the procedures used to troubleshoot electrical components of heating, ventilation and cooling systems.
14. Describe the procedures used to maintain, repair and test electrical components of heating, ventilation and cooling systems.

Practical Requirements:

None.

ER2720 Heating, Ventilation and Cooling System Controls

Learning Outcomes:

- Demonstrate knowledge of heating, ventilation and cooling system controls, their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, program, troubleshoot, maintain, repair and test heating, ventilation and cooling system controls.

Duration: 18 Hours

Pre-Requisite(s): ER2710

Objectives and Content:

1. Define terminology associated with heating, ventilation and cooling system controls.
2. Identify hazards and describe safe work practices pertaining to heating, ventilation and cooling system controls.
3. Interpret codes and regulations pertaining to heating, ventilation and cooling system controls.
4. Interpret information pertaining to heating, ventilation and cooling system controls found on drawings and specifications.
5. Identify tools and equipment relating to heating, ventilation and cooling system controls and describe their applications and procedures for use.
6. Identify types of heating, ventilation and cooling system control devices and describe their characteristics and applications.
 - i. Electrical
 - ii. mechanical

7. Identify considerations and requirements for selecting heating, ventilation and cooling system control devices.
 - i. residential
 - ii. commercial
 - iii. industrial
8. Describe the procedures used to install and connect heating, ventilation and cooling system control devices.
9. Describe the procedures used to program heating, ventilation and cooling system control devices.
10. Describe the procedures used to troubleshoot heating, ventilation and cooling system control devices.
11. Describe the procedures used to maintain, repair and test heating, ventilation and cooling system control devices.

Practical Requirements:

None.

ER2051 Motor Starters and Controls I

Learning Outcomes:

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

Duration: 42 Hours

Pre-Requisite(s): ER2042

Objectives and Content:

1. Define terminology associated with motor starters.
2. Identify hazards and describe safe work practices pertaining to motor starters.
3. Interpret codes and regulations pertaining to motor starters.
4. Interpret information pertaining to motor starters found on drawings and specifications.
5. Identify tools and equipment relating to motor starters and describe their applications and procedures for use.
6. Identify types of starters and controllers and describe their characteristics and applications.
 - i. manual
 - ii. magnetic
7. Identify circuit types and describe their characteristics and applications.
 - i. low voltage release (two wire control)
 - ii. low voltage protection (three wire control)

8. Describe circuit functional features of common hard wired motor control circuits.
 - i. starting and stopping
 - ii. forward/reverse
 - iii. sequencing
 - iv. jogging
 - v. quick stop
 - vi. multiple location control
 - vii. timed functions
9. Identify types of control accessories and describe their characteristics and applications.
10. Identify considerations and requirements for selecting motor starters, their components and accessories.
11. Identify the methods used to determine the number of conductors required between controls and controller locations.
12. Describe the procedures used to install and connect motor starters, their components and accessories.
13. Describe the procedures used to troubleshoot motor starters, their components and accessories.
14. Describe the procedures used to maintain, repair and test motor starters, their components and accessories.
15. Identify protection devices for motor control circuits and describe their characteristics and applications.
 - i. overcurrent
 - ii. overload/overheating
 - iii. phase loss
 - iv. phase reversal

Practical Requirements:

1. Connect and operate common magnetic starters, complete with two-wire and three-wire control devices.
2. Install overload devices.
3. Maintain and troubleshoot control circuits, starters and controllers.
4. Connect and operate manual starters.
5. Install/connect input devices according to specific requirements.
6. Install/connect input devices in a sequential operation.
7. Connect a soft start to a three-wire control.
8. Connect a reduced-voltage starter and motor to a three-wire control system.

ER2055 Motor Starters and Controls II

Learning Outcomes:

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

Duration: 18 Hours

Pre-Requisite(s): ER2051

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to motor starters and controls.
2. Interpret codes and regulations pertaining to motor starters and controls.
3. Interpret information pertaining to motor starters and controls found on drawings and specifications.
4. 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

5. Identify types of motor controllers and describe their characteristics and applications.
 - i. wound rotor motor controller
 - ii. multi-speed controller
 - iii. frequency drives
6. Identify motor controller components and accessories and describe their characteristics and applications.
7. Identify types of motor control centers and describe their characteristics and applications.
8. Identify motor control center components and accessories and describe their characteristics and applications.
9. Describe the procedures used to install and connect motor starters and motor controllers, their components and accessories.
10. Describe the procedures used to troubleshoot motor starters and motor controllers, their components and accessories.
11. Describe the procedures used to maintain, repair and test motor starters and motor controllers, their components and accessories.

Practical Requirements:

None.

ER1301 DC Motors and Controls

Learning Outcomes:

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

Duration: 20 Hours

Pre-Requisite(s): ER2051

Objectives and Content:

1. Define terminology associated with DC motors and controls.
2. Identify hazards and describe safe work practices pertaining to DC motors and controls.
3. Interpret codes and regulations pertaining to DC motors and controls.
4. Interpret information pertaining to DC motors and controls found on drawings and specifications.
5. Identify tools and equipment relating to DC motors and controls and describe their applications and procedures for use.
6. Explain the construction and operating principles of DC motors.
7. Interpret information contained on motor nameplates.
8. Identify types of DC motors and describe their characteristics and applications.
9. Identify DC motor components and accessories and describe their characteristics and applications.

10. Identify types of DC motor controls and describe their characteristics and applications.
11. Identify DC motor control components and accessories and describe their characteristics and applications.
12. Identify the considerations and requirements for selecting DC motors and controls, their components and accessories.
13. Describe the procedures used to install and connect DC motors and controls, their components and accessories.
14. Describe the procedures used to troubleshoot DC motors and controls, their components and accessories.
15. Describe the procedures used to maintain, repair and test DC motors and controls, their components and accessories.

Practical Requirements:

1. Connect and operate DC motors.
2. Identify leads of DC motors.
3. Troubleshoot DC motors.
4. Conduct operational tests pertaining to DC motors and controls.

ER2241 DC Generators

Learning Outcomes:

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

Duration: 10 Hours

Pre-Requisite(s): ER1301

Objectives and Content:

1. Define terminology associated with DC generators.
2. Identify hazards and describe safe work practices pertaining to DC generators.
3. Interpret codes and regulations pertaining to DC generators.
4. Interpret information pertaining to DC generators found on drawings and specifications.
5. Identify tools and equipment relating to DC generators and describe their applications and procedures for use.
6. Explain the generation of DC voltage.
7. Describe the construction of DC generators and explain their operating principles.
8. Identify types of DC generators and describe their characteristics and applications.
 - i. series
 - ii. shunt
 - iii. compound

9. Identify DC generator components and accessories and describe their characteristics and applications.
10. Describe the load/voltage characteristics of separately and static excited generators.
11. Identify the considerations and requirements for selecting DC generators, their components and accessories.
12. Describe the procedures used to install and connect DC generators, their components and accessories.
13. Describe the procedures used to troubleshoot DC generators, their components and accessories.
14. Describe the procedures used to maintain, repair and test DC generators, their components and accessories.

Practical Requirements:

1. Connect and operate DC generators in accordance with CEC requirements.
2. Troubleshoot problems with DC generators.
3. Conduct operational tests pertaining to DC generators.

ER2074 Power Supply and Rectifiers

Learning Outcomes:

- Demonstrate knowledge of power supplies and rectifiers, their applications and operation.

Duration: 58 Hours

Pre-Requisite(s): Block I

Objectives and Content:

1. Define terminology associated with power supply and rectifiers.
2. Identify hazards and describe safe work practices pertaining to power supply and rectifiers.
3. Interpret codes and regulations pertaining to power supply and rectifiers.
4. Interpret information pertaining to power supply and rectifiers found on drawings and specifications.
5. Identify tools and equipment relating to power supply and rectifiers and describe their applications and procedures for use.
6. Identify semiconductor materials and describe their characteristics and applications.

7. Identify power supply and rectifier components and describe their characteristics, applications and operation.
 - i. resistors
 - ii. capacitors
 - iii. inductors
 - iv. diodes
 - PN junction
 - Zener
 - Metal Oxide Varistor (MOV)
 - v. rectifiers
 - single-phase rectifier
 - silicon-controlled rectifier (SCR)
 - TRIAC
 - half-wave three-phase rectifier
 - full-wave three-phase rectifier
 - vi. thyristors
 - vii. transistors
 - bi-polar
 - field effect transistors (FET)
 - uni-junction
 - insulated gate bi-polar junction (IGBT)
8. Explain the effects of power supply and rectifier components on power in an electronic circuit.
9. Identify the methods used to achieve phase control using triggering circuits.
 - i. SCR
 - ii. TRIAC
10. Perform calculations relating to the measurement of power, current and voltage values in rectifier circuits.

Practical Requirements:

1. Use an oscilloscope to measure and test regulated power supply.
2. Connect, operate and troubleshoot half wave and full wave rectifiers.
3. Connect, operate and troubleshoot regulated power supply.
4. Calculate and measure power, current and voltage values in rectifier circuits.

ER2031 Three-Phase Motors

Learning Outcomes:

- Demonstrate knowledge of three-phase motors, their applications and procedures for use.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot, maintain, repair and test three-phase motors.

Duration: 30 Hours

Pre-Requisite(s): Block I

Objectives and Content:

1. Define terminology associated with three-phase motors.
2. Identify hazards and describe safe work practices pertaining to three-phase motors.
3. Interpret codes and regulations pertaining to three-phase motors.
4. Interpret information pertaining to three-phase motors found on drawings and specifications.
5. Identify tools and equipment relating to three-phase motors and describe their applications and procedures for use.
6. Describe the construction of three-phase motors and explain their operating principles.
7. Interpret information contained on motor nameplates.

8. Identify types of three-phase motors and describe their characteristics and applications.
 - i. squirrel cage induction
 - ii. wound rotor induction
 - iii. synchronous
9. Identify three-phase motor components and accessories and describe their characteristics and applications.
10. Identify coupling methods for three-phase motors and describe their characteristics and applications.
11. Identify the considerations and requirements for selecting three-phase motors, their components and accessories.
12. Describe the procedures used to install and connect three-phase motors, their components and accessories.
13. Describe the procedures used to troubleshoot three-phase motors, their components and accessories.
14. Describe the procedures used to maintain, repair and test three-phase motors, their components and accessories.

Practical Requirements:

1. Connect and operate three-phase squirrel cage motors in accordance with CEC requirements.
2. Connect and operate three-phase wound rotor motors in accordance with CEC requirements.

3. Connect and operate three-phase synchronous motors in accordance with CEC requirements.
4. Use proper phase rotation meters to determine the rotation of a motor.
5. Conduct operational tests pertaining to three-phase motors.

ER2251 AC Generators

Learning Outcomes:

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

Duration: 20 Hours

Pre-Requisite(s): ER2031

Objectives and Content:

1. Define terminology associated with AC generators.
2. Identify hazards and describe safe work practices pertaining to AC generators.
3. Interpret codes and regulations pertaining to AC generators.
4. Interpret information pertaining to AC generators found on drawings and specifications.
5. Identify tools and equipment relating to AC generators and describe their applications and procedures for use.
6. Describe the construction of AC generators and explain their operating principles.
7. Identify types of AC generators and describe their characteristics and applications.
 - i. single-phase
 - ii. three-phase

8. Identify AC generator components and accessories and describe their characteristics and applications.
9. Identify the considerations and requirements for selecting AC generators, their components and accessories.
10. Describe the procedures used to install and connect AC generators, their components and accessories.
 - i. stand alone
 - ii. in parallel
11. Describe the procedures used to control the output voltage and frequency of AC generators.
12. Describe the procedures used to troubleshoot AC generators, their components and accessories.
13. Describe the procedures used to maintain, repair and test AC generators, their components and accessories.
14. Describe the protective devices and their purpose for AC generators.
 - i. digital relays
 - ii. mechanical relays
 - iii. reverse current

Practical Requirements:

1. Connect, operate, test and troubleshoot
 - i. AC generators in parallel
 - ii. AC generators
2. Conduct operational tests pertaining to AC generators
 - i. load test
 - ii. metering

BLOCK III

ER4260 Digital Electronics

Learning Outcomes:

- Demonstrate knowledge of digital electronics, their applications and operation.

Duration: 30 Hours

Pre-Requisite(s): Block II

Objectives and Content:

1. Define terminology associated with digital electronics.
2. Describe the number systems used in digital systems.
 - i. Decimal system
 - ii. Octal system
 - iii. Hexadecimal system
 - iv. Conversion between systems
 - v. Binary Coded Decimal (BCD)
 - vi. American Standard Code for Information Interchange (ASCII).
3. Interpret information pertaining to digital electronics found on drawings and specifications.
4. Identify types of logic gates and describe their applications.
 - i. AND gate
 - ii. OR gate
 - iii. NOT gate
 - iv. NAND gate
 - v. NOR gate
 - vi. exclusive-OR circuit

5. Describe the application of Demorgan's theorems.
 - i. Boolean algebra

6. Identify types of circuits and describe their characteristics, features and applications.
 - i. Integrated
 - ii. flip-flop
 - RS type
 - T type
 - D type
 - JK type

7. Identify types of devices related to flip-flop circuits and describe their characteristics, applications and operation.
 - i. multi-vibrators
 - ii. counters
 - iii. shift registers
 - iv. truth tables

8. Identify types of basic optoelectronic components and describe their characteristics, applications and operation.

9. Identify conversion devices and describe their characteristics, applications and operation.
 - i. analog to digital
 - ii. digital to analog

Practical Requirements:

1. Build a clock circuit.

ER4280 Pneumatic Control Systems

Learning Outcomes:

- Demonstrate knowledge of pneumatic control systems, their applications and operation.

Duration: 30 Hours

Pre-Requisite(s): Block II

Objectives and Content:

1. Define terminology associated with pneumatic control systems.
2. Identify hazards and describe safe work practices pertaining to pneumatic control systems.
3. Describe schematics and their applications.
4. Interpret schematics to determine the operation of a pneumatic control system.
5. Identify tools and equipment related to pneumatic control systems and describe their applications and procedures for use.
6. Identify pneumatic control system components and describe their purpose and operation.
 - i. valves
 - ii. actuators
 - iii. positioners
7. Describe the procedures used to perform basic inspection and maintenance of pneumatic control systems and components.
- 8.
9. Describe the procedures used to troubleshoot, repair and test pneumatic control systems and components.

Practical Requirements:

1. Interpret pneumatic drawings and create a circuit.
2. Flare and bend copper tubing.
3. Bench test valve.
4. Calibrate positioner.

ER4100 Distribution System Conditioning

Learning Outcomes:

- Demonstrate knowledge of the methods and equipment used for distribution system conditioning.

Duration: 30 Hours

Pre-Requisite(s): Block II

Objectives and Content:

1. Define terminology associated with distribution system conditioning.
2. Identify hazards and describe safe work practices pertaining to distribution system conditioning.
3. Interpret codes and regulations pertaining to distribution system conditioning.
4. Interpret information pertaining to distribution system conditioning found on drawings and specifications.
5. Identify tools and equipment relating to distribution system conditioning and describe their applications and procedures for use.
6. Explain power quality and its impact on equipment operation.
7. Explain power factor correction and its associated calculations.
8. Identify types of power factor correction equipment and describe their characteristics, applications and operation.
9. Explain harmonics and its impact on power distribution systems.
 - i. harmonics theory
 - triplen
 - linear loads

- non-linear loads
- ii. effects of harmonics on:
 - phase conductors and conduit
 - circuit breakers
 - neutral conductors
 - neutral-to-ground voltage at receptacles
 - neutral bus bar and neutral lug
 - transformers
 - power factor correction capacitors
 - kW and kVar meters
 - multi-meter readings
- 10. Identify equipment used to reduce harmonics in power distribution systems and describe their characteristics, applications and operation.
- 11. Explain voltage fluctuations and their impact on power distribution systems.
- 12. Identify surge suppression equipment used in power distribution system conditioning and describe their characteristics, applications and operation.

Practical Requirements:

1. Demonstrate power quality equipment used to detect harmonics in power distribution systems.

ER4120 High Voltage Breakers and Starters

Learning Outcomes:

- Demonstrate knowledge of high voltage breakers and starters, their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot, maintain, repair and test high voltage breakers and starters.

Duration: 15 Hours

Pre-Requisite(s): Block II

Objectives and Content:

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 and fuse 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.

Practical Requirements:

None.

ER4140 High Voltage Wiring

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.

Duration: 15 Hours

Pre-Requisite(s): ER4120

Objectives and Content:

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 Requirements:

None.

ER4300 Hydraulic Circuits and Control Systems

Learning Outcomes:

- Demonstrate knowledge of hydraulic circuits and control systems, their applications and operation.

Duration: 6 Hours

Pre-Requisite(s): Block II

Objectives and Content:

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. Identify tools and equipment related to hydraulic control systems and describe their applications and procedures for use.
6. Identify hydraulic control system components and describe their purpose and operation.
 - i. pumps
 - ii. motors
 - iii. actuators
 - iv. valves
 - v. accumulators
7. Describe the procedures used to perform basic inspection and maintenance of hydraulic control systems and components.

8. Describe the procedures used to troubleshoot, repair and test hydraulic systems and components.

Practical Requirements:

1. Use schematic diagrams to troubleshoot systems.

ER4320 Vibration Analysis

Learning Outcomes:

- Demonstrate knowledge of the procedures used to perform vibration analysis.

Duration: 6 Hours

Pre-Requisite(s): Block II

Objectives and Content:

1. Define terminology associated with vibration analysis.
2. Identify hazards and describe safe work practices pertaining to vibration analysis.
3. Identify tools and equipment used for vibration analysis and describe their applications and procedures for use.
4. Identify and interpret sources of information pertaining to vibration analysis.
 - i. manufacturers' specifications
 - ii. vibration standards and charts
 - iii. Canadian Machinery Vibration Association (CMVA) interpretations and guidelines
5. Identify causes of vibration.
6. Identify vibration analysis methods and describe their applications.
7. Describe the procedures used to perform vibration analysis.
8. Record and interpret data collected using vibration analysis.

Practical Requirements:

None.

ER4160 Exit / Emergency Lighting Systems

Learning Outcomes:

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

Duration: 10 Hours

Pre-Requisite(s): Block II

Objectives and Content:

1. Define terminology associated with exit/emergency lighting systems.
2. Identify hazards and describe safe work practices pertaining to exit/emergency lighting systems.
3. Interpret codes and regulations pertaining to exit/emergency lighting systems.
 - i. Canadian Electrical Code requirements
 - ii. National Building Code requirements
4. Interpret information pertaining to exit/emergency lighting systems found on drawings and specifications.
5. Identify tools and equipment relating to exit/emergency lighting systems and describe their applications and procedures for use.
6. Identify types of exit/emergency lighting systems and describe their characteristics and applications.
 - i. self-contained
 - ii. central-powered
 - iii. remote lighting units

7. Identify exit/emergency lighting system components and accessories and describe their characteristics and applications.
8. Identify the considerations and requirements for selecting exit/emergency lighting systems, their components and accessories.
9. Describe the procedures used to install and connect exit/emergency lighting systems, their components and accessories.
10. Describe the procedures used to troubleshoot exit/emergency lighting systems, their components and accessories.
11. Describe the procedures used to maintain, repair and test exit/emergency lighting systems, their components and accessories.

Practical Requirements:

None.

ER4180 Emergency Stand-by Units

Learning Outcomes:

- Demonstrate knowledge of emergency stand-by units, their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot, maintain, repair and test emergency stand-by units.

Duration: 25 Hours

Pre-Requisite(s): Block II

Objectives and Content:

1. Define terminology associated with emergency stand-by units.
2. Identify hazards and describe safe work practices pertaining to emergency stand-by units.
3. Interpret codes and regulations pertaining to emergency stand-by units.
 - i. Canadian Electrical Code (CEC) requirements
 - ii. National Building Code (NBC) requirements
 - iii. Canadian Standards Association (CSA) requirements
4. Interpret information pertaining to emergency stand-by units found on drawings and specifications.
5. Identify types of emergency stand-by units and describe their characteristics and applications.
 - i. generator systems
 - ii. uninterruptable power supplies
6. Identify types of batteries and describe their characteristics, applications and maintenance.

7. Identify emergency stand-by unit components and accessories and describe their characteristics and applications.
8. Identify types of transfer switches and describe their characteristics and applications.
 - i. manual
 - ii. automatic
 - iii. meter base generator transfer switch
9. Identify transfer switch components and accessories and describe their characteristics and applications.
10. Identify the considerations and requirements for selecting emergency stand-by units and transfer switches, their components and accessories.
11. Describe the procedures used to install and connect emergency stand-by units and transfer switches, their components and accessories.
12. Describe the procedures used to troubleshoot emergency stand-by units and transfer switches, their components and accessories.
13. Describe the procedures used to maintain, repair and test emergency stand-by units and transfer switches, their components and accessories.

Practical Requirements:

None.

ER4200 Cathodic Protection Systems

Learning Outcomes:

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

Duration: 6 Hours

Pre-Requisite(s): Block II

Objectives and Content:

1. Define terminology associated with cathodic protection systems.
2. Identify hazards and describe safe work practices pertaining to cathodic protection.
3. Interpret codes and regulations pertaining to cathodic protection systems.
4. Interpret information pertaining to cathodic protection systems found on drawings and specifications.
5. Identify tools and equipment relating to cathodic protection systems and describe their applications and procedures for use.
6. Identify types of cathodic protection systems and describe their characteristics, applications and operation.
7. Identify cathodic protection system components and describe their characteristics, applications and operation.
8. Describe the procedures used to install and connect cathodic protection systems and their components.

9. Describe the procedures used to troubleshoot cathodic protection systems and their components.
10. Describe the procedures used to maintain, repair and test cathodic protection systems and their components.

Practical Requirements:

None.

ER4340 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.

Duration: 15 Hours

Pre-Requisite(s): Block II

Objectives and Content:

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 Requirements:

None.

ER4220 Building Automation 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.

Duration: 15 Hours

Pre-Requisite(s): Block II

Objectives and Content:

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 Requirements:

None.

ER2500 Explosion Proof Equipment

Learning Outcomes:

- Demonstrate knowledge of installation, inspection and maintenance of electrical apparatus in explosive gas atmospheres.

Duration: 30 Hours

Pre-Requisite(s): Block II

Objectives and Content:

1. Identify hazardous areas as per the CEC.
 - i. principles and documentation
 - ii. criteria for identification of hazardous areas
 - iii. explosion hazards
2. Identify the various classifications of hazardous atmospheres.
 - i. classes
 - ii. division
3. Identify the grouping of gases and temperature codes.
 - i. gas groups
 - ii. temperature classifications
 - iii. ingress protection
4. Identify apparatus standards, certification and markings.
 - i. standards
 - Canadian Standards Association (CSA)

5. Explain the methods of explosion protection.
 - i. explosion proof or flammable
 - definitions
 - principle of operation
 - ambient conditions
 - joint types
 - cable and conduit entry
 - gap dimensions
 - obstruction of flamepaths
 - weatherproofing
 - ingress protection methods
 - pressure piling
 - modifications
 - electrical protection
 - ii. class 1, division 2
 - definitions
 - principle of operation
 - ambient conditions
 - energy limiting circuit device
 - iii. pressured equipment
 - definitions
 - applications
 - principle of operation
 - purging
 - enclosures
 - safety requirements
 - iv. intrinsic safety
 - principles
 - apparatus
 - equipment marking
 - Zener barrier systems
 - v. oil immersed equipment
 - definitions
 - principle of operation
 - construction

- vi. sand filled equipment
 - definitions
 - principle of operation
 - construction
 - vii. encapsulation
 - definitions
 - principle of operation
 - construction
6. Describe wiring systems, enclosure entries and cable glands.
- i. standards, Canadian Electrical Code (CEC) Part 1
 - ii. wiring methods, cables, conduits
 - iii. installation of conduit, cables and glands
 - class 1, zone 0 locations
 - class 1, zone 1 locations
 - class 1, division 1 location
 - sealing of cables and conduits

Practical Requirements:

None.

ER4240 Introduction to Commissioning

Learning Outcomes:

- Demonstrate knowledge of commissioning and its purpose.

Duration: 6 Hours

Pre-Requisite(s): Block II

Objectives and Content:

1. Define terminology associated with commissioning.
2. Identify hazards and describe safe work practices pertaining to commissioning systems or components.
3. Identify the purpose of commissioning and the types of systems and components requiring it.
4. Identify and interpret information sources and documentation pertaining to the commissioning of systems or components.

Practical Requirements:

None.

BLOCK IV

ER4360 Introduction to Programmable Logic Controllers

Learning Outcomes:

- Demonstrate knowledge of programmable logic controllers (PLCs), their applications and operation.
- Demonstrate knowledge of PLC data highway systems.

Duration: 22 Hours

Pre-Requisite(s): Block III

Objectives and Content:

1. Define terminology associated with PLCs.
2. Identify hazards and describe safe work practices pertaining to PLCs.
 - i. online vs. offline applications
3. Interpret codes and regulations pertaining to PLCs.
4. Interpret information pertaining to PLCs found on drawings and specifications.
5. Identify sources of information pertaining to PLCs maintenance, configuration and programming.
6. Identify number and code systems and describe their applications.
 - i. number
 - binary
 - decimal
 - hexadecimal
 - octal
 - ii. code
 - BCD (binary coded decimal)
 - ASCII

7. Perform conversions between number systems.
8. Explain and interpret control circuit logic.
 - i. relay logic
 - ii. functions (AND, OR, NOT NAND, NOR, XOR) and Boolean Expressions
 - iii. MEMORY types
 - iv. numbering systems (Decimal, Binary, Octal, Hexadecimal, BCD)
9. Identify PLC components and describe their purpose and operation.
 - i. hardware
 - power supply
 - CPU
 - I/O system
 - programming terminals
 - ii. software
10. Describe the procedures used to install and connect PLCs and their components.
11. Describe the procedures used to maintain and replace PLCs and their components.
12. Identify types of PLC data highway systems and describe their characteristics, applications and operation.
13. Identify PLC data highway system components and describe their characteristics, applications and operation.
14. Identify methods used to communicate with PLCs.
 - i. handheld
 - ii. computer
 - iii. human machine interfacing
15. Identify basic instruction sets for ladder logic and describe their applications.
 - i. XIO (examine if opened)
 - ii. XIC (examine if closed)
 - iii. OTE (output energized)
16. Identify programming languages used to program PLCs.

- i. ladder diagram (LD)
 - ii. function block diagram (FBD)
 - iii. structured text (ST)
 - iv. instruction list (IL)
 - v. sequential function chart (SFC)
17. Explain the difference between PLC and Direct Digital Control (DDC) Distributed Control Systems (DCS).

Practical Requirements:

1. Identify the components required to install a basic motor control circuit.
2. Install a basic motor control circuit.
 - i. start / stop
 - ii. feedback
 - iii. output

ER4380 Introduction to Programmable Logic Controller Programming

Learning Outcomes:

- Demonstrate knowledge of programming programmable logic controllers (PLCs).

Duration: 30 Hours

Pre-Requisite(s): ER4360

Objectives and Content:

1. Define terminology associated with PLC programming.
2. Identify hazards and describe safe work practices pertaining to PLCs.
 - i. online vs offline applications
3. Interpret programming languages and describe their applications.
 - i. ladder diagram (LD)
 - ii. function block diagram (FBD)
 - iii. sequential function chart (SFC)
4. Describe the procedures used to configure and program PLCs and their components.
 - i. I/O configuration
 - ii. data table
 - iii. user program
 - iv. communication interface
5. Identify basic instruction set functions in PLC programming.
6. Describe the procedures used to perform basic programming and editing in PLCs.
 - i. online
 - ii. offline

Practical Requirements:

1. Program a PLC using ladder logic or 'instruction set' type language.
2. Conduct operational tests pertaining to PLCs.

ER4440 Introduction to Analog Devices

Learning Outcomes:

- Demonstrate knowledge of operational amplifiers.

Duration: 20 Hours

Pre-Requisite(s): ER4380

Objectives and Content:

1. Describe the features of the operational amplifier.
 - i. symbol
 - ii. packaging

2. Describe the common circuit applications for the operational amplifier.
 - i. inverting op-amp
 - gain
 - ii. non-inverting op-amp
 - gain
 - iii. summing op-amp
 - adding value
 - averaging value
 - iv. voltage comparator

3. Describe basic troubleshooting techniques.
 - i. inputs and outputs

Practical Requirements:

1. Connect, operate, test and troubleshoot:
 - i. inverting amplifiers
 - ii. non-inverting amplifiers
 - iii. voltage follower
 - iv. inverting summer
 - v. non-inverting summer
 - vi. integrator

ER4460 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.

Duration: 90 Hours

Pre-Requisite(s): ER4440

Objectives and Content:

1. Define terminology associated with analog devices.
2. Identify hazards and describe safe work practices pertaining to analog devices.
3. Interpret information pertaining to analog devices found on drawings and specifications.
4. Identify tools and equipment relating to analog devices and describe their applications and procedures for use.
5. Explain the use of analog versus digital devices.
6. Identify types of analog devices and describe their characteristics, applications and operation.
7. Identify analog device components and accessories and describe their characteristics and applications.
8. Identify types of signals used with analog devices and describe their characteristics, applications and operation.
 - i. air
 - ii. current
 - iii. voltage

9. Explain the use of analog devices for measurement.
 - i. pressure
 - ii. temperature
 - iii. flow
 - iv. level
 - v. mass and density
10. Identify the considerations and requirements for selecting analog devices, their components and accessories.
11. Describe the procedures used to install, connect and set analog devices, their components and accessories.
12. Describe the procedures used to calibrate analog devices.
13. Describe the procedures used to troubleshoot analog devices, their components and accessories.
14. Describe the procedures used to repair and test analog devices, their components and accessories.

Practical Requirements:

1. Calibrate analog devices.

ER4480 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.

Duration: 42 Hours

Pre-Requisite(s): ER4460

Objectives and Content:

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. Install, configure, and maintain PLC controlled analog systems.
 - i. describe the applications for PLCs as a process controller
 - ii. describe the procedure used to scale analog I/O signals
 - iii. explain the use of Tag Names
 - iv. explain the configuration of the PID Block.
 - v. describe the procedure used to setup, configure and run a process using a PLC as the PID Controller
 - vi. define HMI
 - vii. describe the procedure used to create and run a HMI

Practical Requirements:

1. Connect, configure, operate and test process control loops.

ER4400 Drives

Learning Outcomes:

- Demonstrate knowledge of solid state DC and variable frequency drives (VFDs), their applications and operation.
- Demonstrate knowledge of the procedures used to install, connect, troubleshoot, adjust, repair and test solid state DC drives and VFDs.

Duration: 30 Hours

Pre-Requisite(s): ER4460

Objectives and Content:

1. Define terminology associated with solid state DC drives and VFDs.
2. Identify hazards and describe safe work practices pertaining to solid state DC drives and VFDs.
3. Interpret codes and regulations pertaining to solid state DC drives and VFDs.
4. Interpret information pertaining to solid state DC drives and VFDs found on drawings and specifications.
5. Identify tools and equipment relating to solid state DC drives and VFDs and describe their applications and procedures for use.
6. Identify types of solid state DC motor controllers and describe their characteristics, applications and operation.
7. Identify solid state DC motor controller components and accessories and describe their characteristics, applications and operation.
8. Identify the considerations and requirements for selecting solid state DC motor controllers, their components and accessories.

9. Describe the procedures used to install and connect solid state DC motor controllers, their components and accessories.
10. Describe the procedures used to adjust solid state DC motor controllers, their components and accessories.
11. Describe the procedures used to troubleshoot solid state DC motor controllers, their components and accessories.
12. Describe the procedures used to repair and test solid state DC motor controllers, their components and accessories.
13. Explain the operating principles of VFDs and their impact on motor performance.
14. Identify types of VFDs and describe their characteristics, applications and operation.
15. Identify VFD components and accessories and describe their characteristics, applications and operation.
16. Identify the considerations and requirements for selecting VFDs, their components and accessories.
17. Describe the procedures used to install and connect VFDs, their components and accessories.
18. Describe the procedures used to adjust VFDs, their components and accessories.
19. Describe the procedures used to troubleshoot VFDs, their components and accessories.

Practical Requirements:

1. Connect, operate, test and troubleshoot solid state DC motor controllers.
2. Connect, operate, test and troubleshoot solid state frequency AC drives (VFDs).

ER4420 Alternative Power Systems

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.

Duration: 6 Hours

Pre-Requisite(s): Block III

Objectives and Content:

1. Define terminology associated with alternative power systems.
 - i. Renewable Energy (RE)
 - ii. grid-connected systems
 - iii. remote power systems
2. Identify hazards and describe safe work practices pertaining to alternative power systems.
3. Interpret codes and regulations pertaining to alternative power systems.
4. Interpret information pertaining to alternative power systems found on drawings and specifications.
5. Identify tools and equipment relating to alternative power systems and describe their applications and procedures for use.
6. Identify types of alternative power systems and describe their characteristics, applications and operation.
 - i. solar (photovoltaic)
 - ii. tidal
 - iii. wind
 - iv. micro hydro

7. Identify alternative power system components and accessories and describe their characteristics, applications and operation.
8. Describe the procedures used to install and connect alternative power systems, their components and accessories.
9. Describe the procedures used to troubleshoot alternative power systems, their components and accessories.
10. Describe the procedures used to repair and test alternative power systems, their components and accessories.

Practical Requirements:

None.

D. Conditions Governing Apprenticeship Training

1.0 General

The following general conditions apply to all apprenticeship training programs approved by the Provincial Apprenticeship and Certification Board (PACB) in accordance with the *Apprenticeship Training and Certification Act (1999)*. If an occupation requires additional conditions, these will be noted in the specific Plan of Training for the occupation. In no case should there be a conflict between these conditions and the additional requirements specified in a certain Plan of Training. All references to Memorandum of Understanding will also apply to Letter of Understanding (LOU) agreements.

2.0 Entrance Requirements

2.1 Entry into the occupation as an apprentice requires:

Indenturing into the occupation by an employer who agrees to provide the appropriate training and work experiences as outlined in the Plan of Training.

2.2 Notwithstanding the above, each candidate must have successfully completed a high school program or equivalent, and in addition may be required to have completed certain academic subjects as specified in a particular Plan of Training. Mature students, at the discretion of the Director of Apprenticeship and Trades Certification, may be registered. A mature student is defined as one who has reached the age of 19 and who can demonstrate the ability and the interest to complete the requirements for certification.

2.3 At the discretion of the Director of Apprenticeship and Trades Certification, credit toward the apprenticeship program may be awarded to an apprentice for previous work experience and/or training as validated through prior learning assessment.

- 2.4 An Application for Apprenticeship form must be duly completed along with a Memorandum of Understanding as applicable to be indentured into an Apprenticeship. The Memorandum of Understanding must contain signatures of an authorized employer representative, the apprentice and an official representing the Provincial Apprenticeship and Certification Board to be valid.
- 2.5 A new Memorandum of Understanding must be completed for each change in an employer during the apprenticeship term.

3.0 Probationary Period

The probationary period for each Memorandum of Understanding will be six months or 900 employment credit hours. Within that period the memorandum may be terminated by either party upon giving the other party and the PACB one week notice in writing.

4.0 Termination of a Memorandum of Understanding

After the probationary period referred to in Section 3.0, the Memorandum of Understanding may be terminated by the PACB by mutual consent of the parties involved, or cancelled by the PACB for proper and sufficient cause in the opinion of the PACB, such as that stated in Section 14.

5.0 Apprenticeship Progression Schedule, Wage Rates and Advanced Training Criteria

Progression Schedule

Industrial Electrician - 7200 Hours			
APPRENTICESHIP LEVEL AND WAGES			
Year	Wage Rate At This Level	Requirements for progression to next level of apprenticeship	When requirements are met, the apprentice will progress to...
1 st	60 %	<ul style="list-style-type: none"> ▪ Completion of Block 1 training ▪ Pass Block 1 exam ▪ Minimum 1800 hours of combined relevant work experience and training 	2 nd Year
2 nd	70%	<ul style="list-style-type: none"> ▪ Completion of Block 2 training ▪ Pass Block 2 exam ▪ Minimum 3600 hours of combined relevant work experience and training 	3 rd Year
3 rd	80%	<ul style="list-style-type: none"> ▪ Completion of Block 3 training ▪ Pass Block 3 exam ▪ Minimum 5400 hours of combined relevant work experience and training 	4 th Year
4 th	90%	<ul style="list-style-type: none"> ▪ Completion of Block 4 training ▪ Minimum 7200 hours of combined relevant work experience and training ▪ Sign-off of all workplace skills in apprentice logbook ▪ Pass certification exam 	Journeyman Certification
<p>Wage Rates</p> <ul style="list-style-type: none"> ▪ Rates are percentages of the prevailing journeyman's wage rate in the place of employment of the apprentice. ▪ Rates must not be less than the wage rate established by the Labour Standards Act (1990), as now in force or as hereafter amended, or by other order, as amended from time to time replacing the first mentioned order. ▪ Rates must not be less than the wage rate established by any collective agreement which may be in force at the apprentice's workplace. ▪ Employers are free to pay wage rates above the minimums specified. <p>Block Exams</p> <ul style="list-style-type: none"> ▪ This program may not currently contain Block Exams, in which case this requirement will be waived until such time as Block Exams are available. <p>Programs with five or more Blocks:</p> <ul style="list-style-type: none"> ▪ Apprentices in these programs are considered fourth year apprentices until they have satisfied all their program requirements and have become journeymen. 			

Industrial Electrician - 7200 Hours		
CLASS CALLS		
Call Level	Requirements for Class Call	Hours awarded for In-School Training
Direct Entry Apprentice: RPL & / or Block 1	<ul style="list-style-type: none"> ▪ Minimum of 1000 hours of relevant work experience ▪ Prior Learning Assessment (PLA) at designated college (if applicable) 	To be determined by the number of courses completed after each class call
Block 2	<ul style="list-style-type: none"> ▪ Minimum of 3000 hours of relevant work experience and training 	243
Block 3	<ul style="list-style-type: none"> ▪ Minimum of 54000 hours of relevant work experience and training 	239
Block 4	<ul style="list-style-type: none"> ▪ Minimum of 7000 hours of relevant work experience and training 	240

Direct Entry Apprentice

- Must complete Block 1 courses through PLA and / or in-school training.
- Block 1 training is to be completed via class calls; up to 16 weeks of training per calendar year.
- Must attend in-school training until Block 1 is complete before attending Blocks 2 or higher

Class Calls at Minimum Hours

- Class calls may not always occur at the minimum hours indicated. Some variation is permitted to allow for the availability of training resources and apprentices.

6.0 Tools

Apprentices shall be required to obtain their own hand tools applicable for the designated occupation of registration or tools as specified by the PACB.

7.0 Periodic Examinations and Evaluation

- 7.1 Every apprentice shall submit to such occupational tests and examinations as the PACB shall direct. If after such occupational tests and examinations the apprentice is found to be making unsatisfactory progress, his/her apprenticeship level and rate of wage shall not be advanced as provided in Section 5 until his/her progress is satisfactory to the Director of Apprenticeship and Trades Certification and his/her date of completion shall be deferred accordingly. Persistent failure to pass required tests shall be a cause for revocation of his/her Memorandum of Understanding.
- 7.2 Upon receipt of reports of accelerated progress of the apprentice, the PACB may shorten the term of apprenticeship and advance the date of completion accordingly.
- 7.3 For each and every course, a formal assessment is required for which 70% is the pass mark. A mark of 70% must be attained in both the theory examination and the practical project assignment, where applicable as documented on an official transcript.
- 7.4 Course credits may be granted through the use of a PACB approved matrix which identifies course equivalencies between designated trades and between current and historical Plans of Training for the same trade.

8.0 Granting of Certificates of Apprenticeship

Upon the successful completion of apprenticeship, the PACB shall issue a Certificate of Apprenticeship.

9.0 Hours of Work

Any hours employed in the performance of duties related to the designated occupation will be credited towards the completion of the term of apprenticeship. Appropriate documentation of these hours must be provided.

10.0 Copies of the Registration for Apprenticeship

The Director of Apprenticeship and Trades Certification shall provide copies of the Registration for Apprenticeship form to all signatories to the document.

11.0 Ratio of Apprentices to Journeypersons

Under normal practice, the ratio of apprentices to journeypersons shall not exceed two apprentices to every one journeyperson employed. Other ratio arrangements would be determined and approved by the PACB.

12.0 Relationship to a Collective Bargaining Agreement

Where applicable in Section 5 of these conditions, Collective Agreements take precedence.

13.0 Amendments to a Plan of Apprenticeship Training

A Plan of Training may be amended at any time by the PACB.

14.0 Employment, Re-Employment and Training Requirements

14.1 The Plan of Training requires apprentices to regularly attend their place of employment.

14.2 The Plan of Training requires apprentices to attend training for that occupation as prescribed by the PACB.

- 14.3 Failure to comply with Sections 14.1 and/or 14.2 will result in cancellation of the Memorandum of Understanding. Apprentices may have their MOUs reinstated by the PACB but would be subject to a commitment to complete the entire program as outlined in the General Conditions of Apprenticeship. Permanent cancellation in the said occupation is the result of non-compliance.
- 14.4 Cancellation of the Memorandum of Understanding to challenge journeyperson examinations, if unsuccessful, would require an apprentice to serve a time penalty of two (2) years before reinstatement as an apprentice or qualifying to receive a class call to training as a registered Trade Qualifier. Cancellation must be mutually agreed upon by the employer and the apprentice.
- 14.5 An employer shall ensure that each apprentice is under the direct supervision of an approved journeyperson supervisor who is located at the same worksite as the apprentice, and that the apprentice is able to communicate with the journeyperson with respect to the task, activity or function that is being supervised.
- 14.6 Under the Plan of Training the employer is required to keep each apprentice employed as long as work is available, and if the apprentice is laid off due to lack of work, to give first opportunity to be hired before another is hired.
- 14.7 The employer will permit each apprentice to attend training programs as prescribed by the PACB.
- 14.8 Apprentices who cannot acquire all the workplace skills at their place of employment will have to be evaluated in a simulated work environment at a PACB authorized training institution and have sign-off done by instructors to meet the requirements for certification.

15.0 Appeals to Decisions Based on Conditions Governing Apprenticeship Training

Persons wishing to appeal any decisions based on the above conditions must do so in writing to the Minister of Advanced Education and Skills within 30 days of the decision.

E. Requirements for Red Seal Endorsement

1. Evidence the required work experiences outlined in this Plan of Training have been obtained. This evidence must be in a format clearly outlining the experiences and must be signed by an appropriate person or persons attesting that these experiences have been obtained to the level required.
2. Successful completion of all required courses in the program.
3. A combination of training from an approved training program and suitable work experience totaling 7200 hours.

Or

A total of 9000 hours of suitable work experience.

4. Completion of a National Red Seal examination, to be set at a place and time determined by the Apprenticeship and Trades Certification Division.

F. Roles and Responsibilities of Stakeholders in the Apprenticeship Process

The apprenticeship process involves a number of stakeholders playing significant roles in the training of apprentices. This section outlines these roles and the responsibilities resulting from them.

The Apprentice:

- completes all required technical training courses as approved by the PACB.
- finds appropriate employment.
- completes all required work experiences in combination with the required hours.
- ensures work experiences are well documented.
- approaches apprenticeship training with an attitude and commitment that fosters the qualities necessary for a successful career as a qualified journeyman.
- obtains the required hand tools as specified by the PACB for each period of training of the apprenticeship program.

The Employer:

- provides high quality work experiences in an environment conducive to learning.
- remunerates apprentices as set out in the Plan of Training or Collective Agreements.
- provides feedback to training institutions, Apprenticeship and Trades Certification Division and apprentices in an effort to establish a process of continuous quality improvement.
- where appropriate, releases apprentices for the purpose of returning to a training institution to complete the necessary technical courses.
- ensures work experiences of the apprentice are documented.
- ensures a certified journeyman is currently on staff in the same trade area as the apprentice and whose certification is recognized by the NL Department of Advanced Education and Skills.

The Training Institution:

- provides a high quality learning environment.
- provides the necessary student support services that will enhance an apprentice's ability to be successful.
- participates with other stakeholders in the continual updating of programs.

The Apprenticeship and Trades Certification Division:

- establishes and maintains program advisory committees under the direction of the PACB.
- promotes apprenticeship training as a viable career option to prospective apprentices and other appropriate persons involved, such as career guidance counsellors, teachers, parents, etc.
- establishes and maintains a protocol with training institutions, employers and other appropriate stakeholders to ensure the quality of apprenticeship training programs.
- ensures all apprentices are appropriately registered and records are maintained as required.
- schedules all necessary technical training periods for apprentices to complete requirements for certification.
- administers block, provincial and interprovincial examinations.

The Provincial Apprenticeship and Certification Board:

- sets policies to ensure the provisions of the *Apprenticeship and Certification Act (1999)* are implemented.
- ensures advisory and examination committees are established and maintained.
- accredits institutions to deliver apprenticeship training programs.
- designates occupations for apprenticeship training and/or certification.