PROGRAM * PROGRAMME **RED SEAL·SCEAU ROUGE**

Interprovincial Program Guide Instrumentation Control Technician 2015

CANADIAN STANDARD OF EXCELLENC FOR SKILLED TRADES

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The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this Interprovincial Program Guide (IPG) as the national curriculum for the occupation of Instrumentation and Control Technician

Jurisdictions have long recognized the benefit of pooling resources in the development and maintenance of apprenticeship training standards. A successful example of this is the Interprovincial Standards Red Seal Program itself. Essential to the establishment of standards is the development of suitable training systems and programs which enable tradespeople to acquire certification based on these standards. While certification is the responsibility of Apprenticeship administrators throughout Canada, the development and delivery of technical training is the responsibility of jurisdictions.

In 1999, work to develop common training for apprenticeship programs within the Atlantic Provinces began. To date, 22 Curriculum Standards have been developed through the Atlantic Standards Partnership (ASP) project to assist programming staff and instructors in the design and delivery of technical training. Similarly, the CCDA embarked on a process for the development of national IPGs for the Boilermaker, Carpenter and Sprinkler System Installer trades. At its January 2005 strategic planning session, the CCDA identified developing common training standards as one of the key activities in moving towards a more cohesive apprenticeship system.

With the support of Employment and Social Development Canada (ESDC), several provinces and territories have partnered to build on the ASP and the CCDA processes to further develop IPGs to be used across the country. This partnership will create efficiencies in time and resources and promote consistency in training and apprentice mobility.

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As this program guide will be amended periodically, comments or suggestions for improvement should be directed to:

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PROGRAM CONTENT

Level 1	
Level 2	
Level 3	
Level 4	

User Guide

According to the Canadian Apprenticeship Forum, the IPG is: "a list of validated technical training outcomes, based upon those sub-tasks identified as common core in the National Occupational Analysis (NOA), and validated by industry in the provinces and territories as incorporating the essential tasks, knowledge and skills associated with a given trade."

Learning outcomes contained in the IPG represent the minimum common core content for the development of jurisdictional training standards and outlines. IPGs are developed based on the NOAs and extensive industry consultation. The IPG is intended to assist program development staff in the design of jurisdictional plans of training. Each jurisdiction has the flexibility to add additional content.

The IPG was deliberately constructed for ease of use and flexibility of structure in order to adapt to all delivery requirements. It details units of training, unit outcomes and objectives. It does not impose a delivery model or teaching format.

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

The IPG document includes a recommended leveling structure to facilitate mobility for apprentices moving from one jurisdiction to another. Because of difference in jurisdictional regulations and program durations, levels are offered as suggestions only.

<u>Structure</u>

The IPG is divided into units. The unit codes are used as a means of identification and are not intended to convey the order of delivery. Prerequisites have not been detailed. Each unit consists of *Learning Outcomes* and *Objectives and Content*.

The *Learning Outcomes* are the specific performances that must be evaluated. Wording of the learning outcomes, "Demonstrate knowledge of...", acknowledges the broad spectrum of ways in which knowledge can be shown. It is at the discretion of each jurisdiction to determine the manner in which learning outcomes are evaluated;

theoretically, practically or a combination of both. NOA references have been detailed in each unit to highlight the direct link between the unit and relevant sub-tasks in the NOA.

The *Objectives and Content* for the unit details the information to be covered in order to achieve the performances specified in the *Learning Outcomes*. These objectives can be either theoretical or practical in nature, based on the requirements identified through the industry consultation process. The learning activities used to cover the objectives are at the discretion of the jurisdiction; however, practically worded objective statements have been used where industry indicated a need for the apprentices to receive exposure to performing the task or skill outlined while attending technical training. For example, this exposure could be done through instructor demonstration or individual or group performance of the skill or task. This practical training will help to reinforce the theoretical component of the technical training.

Detailed content for each objective has not been developed. Where detail is required for clarity, content has been provided. The content listed within the IPG document is **not** intended to represent an inclusive list; rather, it is included to illustrate the intended direction for the objective. Content may be added or extended in jurisdictional training plans as required.

Jurisdictions are free to deliver the IPG units one at a time or concurrently, provided that all *Learning Outcomes* are met. The IPG does not indicate the amount of time to be spent on a particular unit as the length of time required to deliver the *Learning Outcomes* successfully will depend upon the learning activities and teaching methods used.

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

ADJUST	To put in good working order; regulate; bring to a proper state or position.
APPLICATION	The use to which something is put and/or the circumstance in which you would use it.
CALIBRATE	To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter or other device.
CHARACTERISTIC	A feature that helps to identify, tell apart, or describe recognizably; a distinguishing mark or trait.
COMMISSION	The process of testing and ensuring that installed equipment is operating as per engineered design.
COMPONENT	A part that can be separated from or attached to a system; a segment or unit.
CONFIGURE	To set up a program or computer system for a particular application.
DEFINE	To state the meaning of (a word, phrase, etc.).
DESCRIBE	To give a verbal account of; tell about in detail.
DIAGNOSE	To analyze or identify a problem or malfunction.
EXPLAIN	To make plain or clear; illustrate; rationalize.
IDENTIFY	To point out or name objectives or types.
INTERPRET	To translate information from observation, charts, tables, graphs, and written material.

IPG Glossary of Terms (continued)

MAINTAIN	To keep in a condition of good repair or efficiency.
METHOD	A means or manner of doing something that has procedures attached to it.
OPERATE	How an object works; to control or direct the functioning of.
PROCEDURE	A prescribed series of steps taken to accomplish an end.
PROCESS	A physical or chemical change of matter or conversion of energy such as change in pressure, temperature, speed or electrical potential.
PURPOSE	The reason for which something exists or is done, made or used.
SERVICE	Routine inspection and replacement of worn or deteriorating parts. An act or business function provided to a customer in the course of one's profession. (e.g. haircut).
TECHNIQUE	Within a procedure, the manner in which technical skills are applied.
TEST	v. To subject to a procedure that ascertains effectiveness, value, proper function, or other quality.
	n. A way of examining something to determine its characteristics or properties, or to determine whether or not it is working correctly.
TROUBLESHOOT	To follow a systematic procedure to identify and locate a problem or malfunction and its cause.

Essential Skills Profiles

Essential Skills are the skills needed for work, learning and life. They provide the foundation for learning all the other skills that enable people to evolve within their jobs and adapt to workplace change.

Over the past several years, the Government of Canada has conducted research examining the skills people use at work. From this research, Essential Skills Profiles have been developed for various occupations.

For more information regarding Essential Skills and to access Essential Skills Profiles for specific occupations, visit the ESDC Essential Skills website at:

http://www.esdc.gc.ca/eng/jobs/les/profiles/index.shtml

BLOCK A - COMMON OCCUPATIONAL SKILLS					
ICT-100 Safety	ICT-105 Tools and Equipment	ICT-110 Material Handling Equipment	ICT-115 Communication and Trade Documentation		
ICT-120 Introduction to Drawings, Schematics and Specifications	ICT-305 Trade Related Computer Use	ICT-345 Job Planning			
BLOCK B - PROCESS M	EASURING AND INDICA	TING DEVICES			
ICT-155 Introduction to Pressure Measurement and Calibration	ICT-255 Process Measurement	ICT-325 Process Analyzers I	ICT-330 Equipment Monitoring Devices		
ICT-340 Process Analyzers II	ICT-415 Supervisory Control and Data Acquisition Systems				
BLOCK C - SAFETY ANI	D SECURITY SYSTEMS A	ND DEVICES			
ICT-425 Safety Systems and Devices					
BLOCK D - HYDRAULIC	C, PNEUMATIC AND ELE	CTRICAL SYSTEMS			
ICT-125 Direct Current (DC) Theory	ICT-130 Series and Parallel Circuits	ICT-135 Voltage Drop and Power Loss	ICT-140 Conductors and Cables		
ICT-145 On-off Control Devices	ICT-150 Wireways, Raceways and Fittings	ICT-160 Tubing and Piping Systems	ICT-205 Introduction to Fluids		
ICT-235 Final Control Elements	ICT-245 Alternating Current (AC) Theory	ICT-260 Hydraulic Supply Systems and Control Devices	ICT-265 Pneumatic Supply Systems		

BLOCK E - FINAL CONTROL DEVICES					
ICT-270	ICT-320				
Electronics Components	Variable Speed Drives				
(Circuits and Power	(VSDs)				
Supplies)					
BLOCK F - COMMUNIC	ATION SYSTEMS AND I	DEVICES			
ICT-335					
Communication					
Systems and Devices					
BLOCK G - CONTROL S	YSTEMS AND PROCESS	CONTROL			
ICT-300	ICT-410	ICT-415	ICT-420		
Basic Process Control	Advanced Process	Supervisory Control and	Human Machine		
	Control	Data Acquisition	Interface Systems		
		Systems			
ICT-435	ICT-440				
Programmable Logic	Distributed Control				
Controller Systems	Systems				

Recommended Level Structure

Level 1		Level 2			
Unit Code	Title	Page	Unit Code	Title	Page
ICT-100	Safety	22	ICT-205	Introduction to Fluids	46
ICT-105	Tools and Equipment	24	ICT-235	Final Control Elements	47
ICT-110	Material Handling Equipment	26	ICT-245	Alternating Current (AC) Theory	50
ICT-115	Communication and Trade Documentation	27	ICT-255	Process Measurement	52
ICT-120	Introduction to Drawings, Schematics and Specifications	28	ICT-260	Hydraulic Supply Systems and Control Devices	54
ICT-125	Direct Current (DC) Theory	30	ICT-265	Pneumatic Supply Systems	56
ICT-130	Series and Parallel Circuits	32	ICT-270	Electronics Components (Circuits and Power Supplies)	59
ICT-135	Voltage Drop and Power Loss	33			
ICT-140	Conductors and Cables	34			
ICT-145	On-off Control Devices	36			
ICT-150	Wireways, Raceways and Fittings	38			
ICT-155	Introduction to Pressure Measurement and Calibration	40			
ICT-160	Tubing and Piping Systems	42			
Level 3			Level 4		
Unit Code	Title	Page	Unit Code	Title	Page
ICT-300	Basic Process Control	64	ICT-410	Advanced Process Control	82
ICT-305	Trade Related Computer Use	67	ICT-415	Supervisory Control and Data Acquisition Systems	84
ICT-320	Variable Speed Drives (VSDs)	68	ICT-420	Human Machine Interface Systems	86
ICT-325	Process Analyzers I	70	ICT-425	Safety Systems and Devices	88
ICT-330	Equipment Monitoring Devices	72	ICT-435	Programmable Logic Controller Systems	90
ICT-335	Communication Systems and Devices	74	ICT-440	Distributed Control Systems	92
ICT-340	Process Analyzers II	77			
ICT-345	Job Planning	79			

2013 NOA Sub-task to IPG Unit Comparison

NOA Sub-task		IPG Unit		
Task 1 - Performs safety-related functions.				
1.01	Maintains safe work environment.	ICT-100	Safety	
1.02	Uses personal protective	ICT-100	Safety	
	equipment (PPE) and safety			
	equipment.			
1.03	Performs de-energizing, lock-out	ICT-100	Safety	
	and tag-out procedures.			
Task 2 - O1	ganizes work.			
2.01	Uses diagrams, drawings and	ICT-120	Introduction to Drawings,	
	schematics		Schematics and Specifications	
2.02	Plans tasks	ICT-345	Job Planning	
Task 3 - Pe	rforms routine trade activities.			
3.01	Maintains calibration,	ICT-105	Tools and Equipment	
	configuration and test equipment.			
3.02	Maintains tools.	ICT-105	Tools and Equipment	
3.03	Maintains documentation	ICT-115	Communication and Trade	
			Documentation	
3.04	Operates material handling	ICT-110	Material Handling Equipment	
	equipment.			
Task 4 – Installs and services pressure, temperature, level and flow devices.				
4.01	Installs pressure, temperature,	ICT-155	Introduction to Pressure	
	level and flow devices.		Measurement and Calibration	
		ICT-255	Process Measurement	
4.02	Maintains pressure, temperature,	ICT-155	Introduction to Pressure	
	level and flow devices.		Measurement and Calibration	
		ICT-255	Process Measurement	
4.03	Diagnoses pressure, temperature,	ICT-155	Introduction to Pressure	
	level and flow devices.		Measurement and Calibration	
		ICT-255	Process Measurement	
4.04	Repairs pressure, temperature,	ICT-155	Introduction to Pressure	
	level and flow devices.		Measurement and Calibration	
		ICT-255	Process Measurement	
Task 5 - In	stalls and services motion, speed, pos	sition and vil	pration devices.	
5.01	Installs motion, speed, position	ICT-330	Equipment Monitoring Devices	
	and vibration devices.			
5.02	Maintains motion, speed, position	ICT-330	Equipment Monitoring Devices	
	and vibration devices.			

	NOA Sub-task	IPG Unit		
5.03	Diagnoses motion, speed, position and vibration devices.	ICT-330	Equipment Monitoring Devices	
5.04	Repairs motion, speed, position and vibration devices.	ICT-330	Equipment Monitoring Devices	
Task 6 - Ins	stalls and services mass, density and	consistency d	levices.	
6.01	Installs mass, density and	ICT-325	Process Analyzers I	
	consistency devices.	ICT-340	Process Analyzers II	
6.02	Maintains mass, density, and	ICT-325	Process Analyzers I	
	consistency devices.	ICT-340	Process Analyzers II	
6.03	Diagnoses mass, density, and	ICT-325	Process Analyzers I	
	consistency devices.	ICT-340	Process Analyzers II	
6.04	Repairs mass, density and	ICT-325	Process Analyzers I	
	consistency devices.	ICT-340	Process Analyzers II	
Task 7 - Ins	stalls and services process analyzers.			
7.01	Installs process analyzers.	ICT-325	Process Analyzers I	
		ICT-340	Process Analyzers II	
7.02	Maintains process analyzers.	ICT-325	Process Analyzers I	
		ICT-340	Process Analyzers II	
7.03	Diagnoses process analyzers.	ICT-325	Process Analyzers I	
		ICT-340	Process Analyzers II	
7.04	Repairs process analyzers.	ICT-325	Process Analyzers I	
		ICT-340	Process Analyzers II	
Task 8 - Installs and services multiple variable computing devices.				
8.01	Installs multiple variable	ICT-415	Supervisory and Data	
	computing devices.		Acquisition Systems	
8.02	Maintains multiple variable	ICT-415	Supervisory and Data	
	computing devices.		Acquisition Systems	
8.03	Diagnoses multiple variable	ICT-415	Supervisory and Data	
	computing devices.		Acquisition Systems	
8.04	Repairs multiple variable	ICT-415	Supervisory and Data	
	computing devices.		Acquisition Systems	
Task 9 - Ins	stalls and services safety systems and	l devices.		
9.01	Installs safety systems and devices.	ICT-425	Safety Systems and Devices	
9.02	Maintains safety systems and	ICT-425	Safety Systems and Devices	
	devices.			
9.02	Diagnoses safety systems and devices.	ICT-425	Safety Systems and Devices	
9.04	Repairs safety systems and devices.	ICT-425	Safety Systems and Devices	

NOA Sub-task		IPG Unit	
Task 10 - In	nstalls and services facility security s	ystems. (NOT	COMMON CORE)
10.01	Installs facility security systems.		
10.02	(NOT COMMON CORE)		
10.02	Maintains facility security systems.		
10.02	(NOT COMMON CORE)		
10.03	(NOT COMMON CORE)		
10.04	Repairs facility security systems.		
	(NOT COMMON CORE)		
Task 11 - In	nstalls and services safety instrument	ted systems (S	SISs).
11.01	Installs SISs.	ICT-425	Safety Systems and Devices
11.02	Configures SISs.	ICT-425	Safety Systems and Devices
11.03	Maintains SISs.	ICT-425	Safety Systems and Devices
11.04	Diagnoses SISs.	ICT-425	Safety Systems and Devices
11.05	Repairs SISs.	ICT-425	Safety Systems and Devices
Task 12 - In	nstalls and services control devices fo	or hydraulic s	ystems.
12.01	Installs control devices for	ICT-160	Tubing and Piping Systems
	hydraulic systems.	ICT-205	Introduction to Fluids
		ICT-260	Hydraulic Supply Systems and
			Control Devices
12.02	Maintains control devices for	ICT-160	Tubing and Piping Systems
	hydraulic systems.	ICT-205	Introduction to Fluids
		ICT-260	Hydraulic Supply Systems and
			Control Devices
12.03	Diagnoses control devices and	ICT-160	Tubing and Piping Systems
	hydraulic systems.	ICT-205	Introduction to Fluids
		ICT-260	Hydraulic Supply Systems and
			Control Devices
12.04	Repairs control devices for	ICT-160	Tubing and Piping Systems
	hydraulic systems.	ICT-205	Introduction to Fluids
		ICT-260	Hydraulic Supply Systems and
			Control Devices
Task 13 - In	nstalls and services pneumatic equip	ment.	
13.01	Installs pneumatic equipment.	ICT-160	Tubing and Piping Systems
		ICT-205	Introduction to Fluids
		ICT-265	Pneumatic Supply Systems
13.02	Maintains pneumatic equipment.	ICT-160	Tubing and Piping Systems
		ICT-205	Introduction to Fluids
		ICT-265	Pneumatic Supply Systems
13.03	Diagnoses pneumatic equipment.	ICT-160	Tubing and Piping Systems
		ICT-205	Introduction to Fluids
		ICT-265	Pneumatic Supply Systems

	NOA Sub-task		IPG Unit
13.04	Repairs pneumatic equipment.	ICT-160	Tubing and Piping Systems
		ICT-205	Introduction to Fluids
		ICT-265	Pneumatic Supply Systems
Task 14 - In	nstalls and services electrical and elec	ctronic equip	ment.
14.01	Installs electrical and electronic	ICT-125	Direct Current (DC) Theory
	equipment.	ICT-130	Series and Parallel Circuits
		ICT-135	Voltage Drop and Power Loss
		ICT-140	Conductors and Cables
		ICT-145	On-Off Control Devices
		ICT-150	Wireways, Raceways and Fittings
		ICT-270	Electronics Components
			(Circuits and Power Supplies)
		IC1-245	Theory
		ICT-320	Variable Speed Drives (VSDs)
14.02	Maintains electrical and electronic	ICT-125	Direct Current (DC) Theory
	equipment.	ICT-130	Series and Parallel Circuits
		ICT-135	Voltage Drop and Power Loss
		ICT-140	Conductors and Cables
		ICT-145	On-Off Control Devices
		ICT-150	Wireways, Raceways and Fittings
		ICT-270	Electronics Components
			(Circuits and Power Supplies)
		ICT-245	Alternating Current (AC)
			Theory
		ICT-320	Variable Speed Drives (VSDs)
14.03	Diagnoses electrical and electronic	ICT-125	Direct Current (DC) Theory
	equipment.	ICT-130	Series and Parallel Circuits
		ICT-135	Voltage Drop and Power Loss
		ICT-140	Conductors and Cables
		ICT-145	On-Off Control Devices
		ICT-150	Wireways, Raceways and
			Fittings
		ICT-270	Electronics Components
			(Circuits and Power Supplies)
		ICT-245	Alternating Current (AC)
			Theory
		ICT-320	Variable Speed Drives (VSDs)
14.04	Repairs electrical and electronic	ICT-125	Direct Current (DC) Theory
	equipment.	ICT-130	Series and Parallel Circuits
		ICT-135	Voltage Drop and Power Loss

NOA Sub-task		IPG Unit				
		ICT-140	Conductors and Cables			
		ICT-145	On-Off Control Devices			
		ICT-150	Wireways, Raceways and			
			Fittings			
		ICT-270	Electronics Components			
			(Circuits and Power Supplies)			
		ICT-245	Alternating Current (AC)			
		ICT-320	Variable Speed Drives (VSDs)			
Task 15 - Installs and services valves						
15.01	Installs valves.	ICT-235	Final Control Elements			
15.02	Maintains valves.	ICT-235	Final Control Elements			
15.03	Diagnoses valves.	ICT-235	Final Control Elements			
15.03	Repairs valves.	ICT-235	Final Control Elements			
Task 16 - In	nstalls and services actuators.		1			
16.01	Installs actuators.	ICT-235	Final Control Elements			
16.02	Maintains actuators.	ICT-235	Final Control Elements			
16.03	Diagnoses actuators.	ICT-235	Final Control Elements			
16.04	Repairs actuators.	ICT-235	Final Control Elements			
Task 17 - In	nstalls and services positioners.	·	·			
17.01	Installs positioners.	ICT-235	Final Control Elements			
17.02	Maintains positioners.	ICT-235	Final Control Elements			
17.03	Diagnoses positioners.	ICT-235	Final Control Elements			
17.04	Repairs positioners.	ICT-235	Final Control Elements			
Task 18 - C	onfigures and services variable speed	d drives (VSI	Ds).			
18.01	Configures VSDs.	ICT-320	Variable Speed Drives (VSDs)			
18.02	Maintains VSDs.	ICT-320	Variable Speed Drives (VSDs)			
18.03	Diagnoses VSDs.	ICT-320	Variable Speed Drives (VSDs)			
18.04	Repairs VSDs.	ICT-320	Variable Speed Drives (VSDs)			
Task 19 - Installs and services control network systems.						
19.01	Performs installation and	ICT-335	Communication Systems and			
	configuration on control network		Devices			
19.02	Diagnoses control network	ICT-335	Communication Systems and			
17.02	systems.	101 000	Devices			
19.03	Performs maintenance and repairs	ICT-335	Communication Systems and			
	on control network systems.		Devices			
Task 20 - Installs and services signal converters.						
20.01	Performs installation and	ICT-335	Communication Systems and			
	configuration of signal converters.		Devices			
20.02	Diagnoses signal converters.	ICT-335	Communication Systems and Devices			

NOA Sub-task		IPG Unit				
20.03	Performs maintenance and repairs	ICT-335	Communication Systems and			
	on signal converters.		Devices			
Task 21 - Installs and services gateways, bridges and media converters.						
21.01	Performs installation and	ICT-335	Communication Systems and			
	configuration of gateways, bridges		Devices			
	and media converters.					
21.02	Diagnoses gateways, bridges and	ICT-335	Communication Systems and			
	media converters.		Devices			
21.03	Performs maintenance and repairs	ICT-335	Communication Systems and			
	on gateways, bridges and media		Devices			
	converters.					
Task 22 - Establishes and optimizes process control strategies.						
22.01	Determines process control	ICT-300	Basic Process Control			
	strategy.	ICT-410	Advanced Process Control			
22.02	Optimizes process control.	ICT-300	Basic Process Control			
		ICT-410	Advanced Process Control			
Task 23 - Installs and services stand-alone controllers (SACs).						
23.01	Installs SACs.	ICT-300	Basic Process Control			
		ICT-410	Advanced Process Control			
23.02	Configures SACs.	ICT-300	Basic Process Control			
		ICT-410	Advanced Process Control			
23.03	Performs maintenance, diagnostics	ICT-300	Basic Process Control			
	and repairs on SACs.	ICT-410	Advanced Process Control			
Task 24 - I	nstalls and services programmable lo	gic controller	rs (PLCs).			
24.01	Installs PLCs.	ICT-435	Programmable Logic Controller			
			Systems			
24.02	Configures PLCs.	ICT-435	Programmable Logic Controller			
			Systems			
24.03	Performs maintenance, diagnosis	ICT-435	Programmable Logic Controller			
	and repairs on PLCs.		Systems			
Task 25 - I	nstalls and services distributed contro	ol systems (D	CSs).			
25.01	Installs DCSs.	ICT-440	Distributed Control Systems			
25.02	Configures DCSs.	ICT-440	Distributed Control Systems			
25.03	Performs maintenance, diagnosis	ICT-440	Distributed Control Systems			
	and repairs on DCSs.					
Task 26 - Installs and services human machine interface (HMI).						
26.01	Installs HMIs.	ICT-420	Human Machine Interface			
			Systems			
26.02	Configures HMIs.	ICT-420	Human Machine Interface			
			Systems			
26.03	Performs maintenance, diagnosis	ICT-420	Human Machine Interface			
	and repairs on HMIs.		Systems			

NOA Sub-task		IPG Unit				
Task 27 - Installs and services Supervisory Control and Data Acquisition (SCADA) systems.						
27.01	Installs SCADA systems.	ICT-415	Supervisory Control and Data			
			Acquisition Systems			
27.02	Configures SCADA systems.	ICT-415	Supervisory Control and Data			
			Acquisition Systems			
27.03	Performs maintenance, diagnosis	ICT-415	Supervisory Control and Data			
	and repairs on SCADA systems.		Acquisition Systems			

LEVEL 1

ICT-100 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.

2013 National Occupational Analysis Reference:

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

- 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
 - ii) workplace
 - energy state awareness
 - isolation and de-energizing procedures
 - tag out/lockout
 - confined space
 - fire
 - heights
 - nuclear
 - chemical/gas
 - arc flash
 - temperature extremes
 - iii) environmental
 - discharge/spills
- 4. Identify and describe workplace safety and health regulations.
 - i) federal
 - Material Safety Data Sheets (MSDS)
 - Workplace Hazardous Material Information System (WHMIS)

- Transportation of Dangerous Goods (TDG)
- Atomic Energy Control Act and Regulations
- ii) provincial/territorial
- iii) municipal

ICT-105 Tools and Equipment

Learning Outcomes:

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

2013 National Occupational Analysis Reference:

- 3.01 Maintains calibration, configuration and test equipment.
- 3.02 Maintains tools.

- 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 portable power tools and describe their applications and procedures for use.
 - i) electric
 - ii) hydraulic
 - iii) pneumatic
 - iv) powder actuated tools
- 4. Describe the procedures used to inspect and maintain portable power tools.
- 5. Identify types of stationary power tools and describe their applications and procedures for use.
 - i) electric
 - ii) hydraulic
 - iii) pneumatic
- 6. Describe the procedures used to inspect and maintain stationary power tools.

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

ICT-110 Material Handling Equipment

Learning Outcomes:

- Demonstrate knowledge of material handling equipment and accessories, their applications and limitations.

2013 National Occupational Analysis Reference:

3.04 Operates material handling equipment.

- 1. Define terminology associated with material handling equipment and accessories.
- 2. Identify hazards and describe safe work practices pertaining to material handling.
 - i) load considerations
 - ii) supervision of material handling
 - iii) securing work area
 - iv) communication
- 3. Identify codes and regulations pertaining to material handling.
- 4. Identify types of material handling equipment and accessories and describe their applications and limitations.
 - i) rigging equipment
 - ii) pallet jacks
 - iii) forklifts
 - iv) stationary cranes
- 5. Describe the procedures used to inspect and store material handling equipment.

ICT-115 Communication and Trade Documentation

Learning Outcomes:

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

2013 National Occupational Analysis Reference:

3.03 Maintains documentation.

- 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/manuals
 - ii) codes and standards
 - iii) work orders
 - iv) maintenance schedules
 - v) commissioning/calibration/maintenance records

ICT-120 Introduction to 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, schematics and specifications.
- Demonstrate knowledge of maintaining drawings, schematics and specifications.

2013 National Occupational Analysis Reference:

2.01 Uses diagrams, drawings and schematics.

- 1. Define terminology associated with drawings, schematics and specifications.
- 2. Identify types of drawings and describe their applications.
 - i) mechanical
 - plant layout
 - process equipment details
 - ii) process
 - piping and instrument drawings (P&ID)
 - Scientific Apparatus Manufacturers Association (SAMA)
 - loop drawings
 - International Society of Automation (ISA)
 - iii) electrical
 - schematics
 - wiring diagrams
- 3. Interpret and extract information from drawings.
 - i) lines
 - ii) legends
 - iii) symbols and abbreviations
 - iv) notes and specifications

- 4. Interpret and extract information from schematics and specifications.
- 5. Describe the procedures used to revise drawings, schematics and specifications.
 - i) as-builts
 - ii) document control

ICT-125 Direct Current (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.

2013 National Occupational Analysis Reference:

- 14.01 Installs electrical and electronic equipment.
- 14.02 Maintains electrical and electronic equipment.
- 14.03 Diagnoses electrical and electronic equipment.
- 14.04 Repairs electrical and electronic equipment.

- 1. Define terminology associated with DC electricity.
- 2. Identify hazards and describe safe work practices pertaining to DC electricity.
- 3. Explain the atomic structure of matter.
- 4. Identify the forms of energy that produce electricity and describe their associated principles.
 - i) chemical action
 - ii) piezoelectric effect
 - iii) magnetism
 - iv) heat
 - v) light and solar
 - vi) friction
- 5. Identify the components of an electric circuit and describe the procedures used to analyze them.
 - i) electron path (conductors)
 - closed circuit
 - open circuit
 - short circuit

- ii) load
- iii) source
- iv) control
- 6. Identify units of measure and symbols pertaining to DC electricity.
- 7. Explain Ohm's Law.
- 8. Identify the basic electrical properties and describe their relationship.
 - i) voltage
 - ii) current
 - iii) resistance
 - iv) power
- 9. Explain the effects of resistance/capacitance (RC) on DC circuits.
- 10. Identify instruments used for measuring electricity and describe their applications and procedures for use.
- 11. Perform calculations to determine electricity related values.
- 12. Use instruments to troubleshoot DC components.

ICT-130 Series and Parallel Circuits

Learning Outcomes:

- Demonstrate knowledge of series, parallel and complex circuits, their characteristics and operation.

2013 National Occupational Analysis Reference:

- 14.01 Installs electrical and electronic equipment.
- 14.02 Maintains electrical and electronic equipment.
- 14.03 Diagnoses electrical and electronic equipment.
- 14.04 Repairs electrical and electronic equipment.

- 1. Define terminology associated with series and parallel circuits.
- 2. Explain the characteristics and operation of series circuits.
- 3. Explain the characteristics and operation of parallel circuits.
- 4. Identify complex series-parallel circuits and describe their characteristics and operation.
- 5. Explain Kirchhoff's Laws.
 - i) current
 - ii) voltage
- 6. Perform calculations to determine series, parallel and complex circuit related values.
- 7. Describe the procedures used to troubleshoot series, parallel and complex circuits.
- 8. Use test equipment to troubleshoot series, parallel and complex circuits.

ICT-135 Voltage Drop and Power Loss

Learning Outcomes:

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

2013 National Occupational Analysis Reference:

- 14.01 Installs electrical and electronic equipment.
- 14.02 Maintains electrical and electronic equipment.
- 14.03 Diagnoses electrical and electronic equipment.
- 14.04 Repairs electrical and electronic equipment.

- 1. Define terminology associated with voltage drop and power loss.
- Interpret codes and regulations pertaining to voltage drop and power loss.
 i) Canadian Electrical Code
- 3. Identify types of conductors and describe their characteristics and applications.
- 4. Identify the units of measure used to describe conductor size.
- 5. Identify types of insulators and describe their characteristics and applications.
- 6. Explain conductor resistance and its effect on a circuit.
- 7. Describe the procedures used to determine conductor resistance.
- 8. Explain line voltage drop and its effect on a circuit.
- 9. Perform calculations to determine line voltage drop.
- 10. Explain power loss and its effect on a circuit.
- 11. Perform calculations to determine power loss.

ICT-140 Conductors and Cables

Learning Outcomes:

- Demonstrate knowledge of conductor and cable components.
- Demonstrate knowledge of conductor and cable accessories.
- Demonstrate knowledge of the procedures used to install conductors and cables.
- Demonstrate knowledge of the procedures used to terminate conductors.

2013 National Occupational Analysis Reference:

- 14.01 Installs electrical and electronic equipment.
- 14.02 Maintains electrical and electronic equipment.
- 14.03 Diagnoses electrical and electronic equipment.
- 14.04 Repairs electrical and electronic equipment.

- 1. Define terminology associated with conductors and cables.
- 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
- 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.
 - i) power/distribution
 - ii) signal/control
 - iii) communication/data
- 7. Identify cable components and describe their characteristics and applications.
 - i) mechanical
 - ii) electrical
- 8. Identify conductor and cable accessories and describe their characteristics and applications.
 - i) connectors
 - ii) supports
- 9. Identify methods of circuit protection and describe their characteristics and applications.
- 10. Identify the considerations used when selecting conductors and cables and their associated components and accessories.
- 11. Describe the procedures used to install conductors and cables and their associated components and accessories.
- 12. Describe the procedures used to ground, bond and shield conductors and cables.
 - i) power/distribution
 - ii) signal/control
 - iii) communication/data
- 13. Describe the methods used to terminate conductors.
 - i) terminal blocks
 - ii) conical springs (twist-on wire connectors, wire nuts)
 - iii) crimp lugs
 - iv) solder joints

ICT-145 On-off Control Devices

Learning Outcomes:

- Demonstrate knowledge of on-off control devices, their components, operation and applications.
- Demonstrate knowledge of the procedures used to install, maintain, troubleshoot and replace on-off control devices.

2013 National Occupational Analysis Reference:

- 14.01 Installs electrical and electronic equipment.
- 14.02 Maintains electrical and electronic equipment.
- 14.03 Diagnoses electrical and electronic equipment.
- 14.04 Repairs electrical and electronic equipment.

- 1. Define terminology associated with on-off control devices.
- 2. Identify hazards and describe safe work practices pertaining to on-off control devices.
 - i) energy state awareness
- 3. Interpret codes and regulations pertaining to on-off control devices.
- 4. Interpret information pertaining to on-off control devices found on drawings, specifications and nameplates.
- 5. Identify types of on-off control devices and describe their characteristics.
 - i) pushbuttons
 - ii) switches
 - limit
 - proximity
 - centrifugal
 - thermal
 - iii) photo sensors
 - iv) relays
- 6. Identify the applications for on-off control devices.
 - i) hazardous locations
 - ii) non-hazardous locations

- iii) environment conditions
- iv) process conditions
- 7. Describe the procedures used to install on-off control devices.
- 8. Describe the procedures used to maintain, troubleshoot and replace on-off control devices.

ICT-150 Wireways, Raceways and Fittings

Learning Outcomes:

- Demonstrate knowledge of wireways, raceways and fittings, their characteristics and applications.
- Demonstrate knowledge of the procedures used to install wireways, raceways and fittings.

2013 National Occupational Analysis Reference:

- 14.01 Installs electrical and electronic equipment.
- 14.02 Maintains electrical and electronic equipment.
- 14.03 Diagnoses electrical and electronic equipment.
- 14.04 Repairs electrical and electronic equipment.

- 1. Define terminology associated with wireways, raceways and fittings.
- 2. Identify hazards and describe safe work practices pertaining to wireways, raceways and fittings.
- 3. Identify tools and equipment relating to wireways, raceways and fittings and describe their applications and procedures for use.
- 4. Interpret codes and regulations pertaining to wireways, raceways and fittings.
- 5. Interpret information pertaining to wireways, raceways and fittings found on drawings and specifications.
- 6. Identify types of wireways and raceways and describe their characteristics and applications.
 - i) cable tray
 - power
 - instrument
 - ii) conduit
 - rigid
 - PVC
 - flexible
 - iii) electrical metallic tubing (EMT)

- 7. Identify wireway and raceway accessories and describe their characteristics and applications.
- 8. Describe the procedures used to bend conduit and EMT.
- 9. Describe the procedures used to install wireways and raceways and their fittings and accessories.

ICT-155 Introduction to Pressure Measurement and Calibration

Learning Outcomes:

- Demonstrate knowledge of pressure measurement and calibration.
- Demonstrate knowledge of the procedures used to install, calibrate, maintain and troubleshoot basic pressure measurement devices.

2013 National Occupational Analysis Reference:

- 4.01 Installs pressure, temperature, level and flow devices.
- 4.02 Maintains pressure, temperature, level and flow devices.
- 4.03 Diagnoses pressure, temperature, level and flow devices.
- 4.04 Repairs pressure, temperature, level and flow devices.

- 1. Define terminology associated with pressure measurement and calibration.
- 2. Identify hazards and describe safe work practices pertaining to pressure measurement and calibration.
 - i) physical locations
 - ii) process conditions
 - iii) electrical
- 3. Identify tools and equipment relating to pressure measurement and calibration and describe their applications and procedures for use.
- 4. Interpret information pertaining to pressure measuring devices found on drawings, specifications and nameplates.
- 5. Interpret and maintain calibration records.
- 6. Identify units of measure used to express pressure measurement values.
- 7. Perform conversions and calculations relating to pressure measurement.
- 8. Explain the principles of pressure measurement and its relationship to temperature, level and flow.

- 9. Identify types of basic pressure measurement fluid mediums and describe their applications.
 - i) pneumatic
 - ii) hydraulic
- 10. Identify pressure related calibration standards and describe their applications.
 - i) primary
 - ii) secondary
- 11. Identify pressure related calibration test equipment and describe their applications.
 - i) dead weight tester
 - ii) manometer
 - iii) test gauges and calibrators
- 12. Describe the procedures used to install basic pressure measurement devices.
 - i) gauges
 - ii) recorders
 - iii) switches
 - iv) transmitters
- 13. Calibrate basic pressure measurement devices.
- 14. Describe the procedures used to maintain and troubleshoot basic pressure measurement devices.

ICT-160 Tubing and Piping Systems

Learning Outcomes:

- Demonstrate knowledge of tubing and piping systems, their components and operation.
- Demonstrate knowledge of the procedures used to install, maintain and troubleshoot tubing and piping systems and their components.

2013 National Occupational Analysis Reference:

- 12.01 Installs control devices for hydraulic systems.
- 12.02 Maintains control devices for hydraulic systems.
- 12.03 Diagnoses control devices for hydraulic systems.
- 12.04 Repairs control devices for hydraulic systems.
- 13.01 Installs pneumatic equipment.
- 13.02 Maintains pneumatic equipment.
- 13.03 Diagnoses pneumatic equipment.
- 13.04 Repairs pneumatic equipment.

- 1. Define terminology associated with tubing and piping systems.
- 2. Identify hazards and describe safe work practices pertaining to tubing and piping systems.
- 3. Identify tools and equipment relating to tubing and piping systems and describe their applications and procedures for use.
- 4. Interpret codes and regulations pertaining to tubing and piping systems.
- 5. Interpret information pertaining to tubing and piping systems found on drawings and specifications.
- 6. Identify types of tubing and piping systems and describe their applications.
 - i) rigid
 - ii) flexible
 - tubing
 - hoses
 - iii) ferrous
 - iv) non-ferrous

- 7. Identify types of tubing and piping and describe their compatibility, characteristics and applications.
 - i) hydraulic
 - ii) pneumatic
- 8. Identify types of tube and pipe fittings and accessories and describe their characteristics and applications.
- 9. Identify types of valves used in tubing and piping systems and describe their applications and operation.
 - i) isolation
 - ii) throttling
 - iii) regulating
- 10. Describe the procedures used to select and install tubing and piping system components and accessories.
- 11. Perform tube bending and installation.
- 12. Describe the procedures used to maintain and troubleshoot tubing and piping systems and components.

LEVEL 2

ICT-205 Introduction to Fluids

Learning Outcomes:

- Demonstrate knowledge of the principles and applications of fluids.

2013 National Occupational Analysis Reference:

- 12.01 Installs control devices for hydraulic systems.
- 12.02 Maintains control devices for hydraulic systems.
- 12.03 Diagnoses control devices for hydraulic systems.
- 12.04 Repairs control devices for hydraulic systems.
- 13.01 Installs pneumatic equipment.
- 13.02 Maintains pneumatic equipment.
- 13.03 Diagnoses pneumatic equipment.
- 13.04 Repairs pneumatic equipment.

- 1. Define terminology associated with fluids.
- 2. Identify hazards and describe safe work practices pertaining to fluids.
 - i) pressure
 - ii) temperature
 - iii) chemical
- 3. Explain the principles and theories of fluids.
 - i) Pascal's law
 - ii) Boyle's law
 - iii) Charles' law
 - iv) Combined Gas law
 - v) Bernoulli's principle
- 4. Describe units of measure as they relate to fluids.
- 5. Identify fluid related formulas and describe their applications.
- 6. Identify fluid related symbols and abbreviations found on drawings and schematics.

ICT-235 Final Control Elements

Learning Outcomes:

- Demonstrate knowledge of final control elements, their accessories, components and operation.
- Demonstrate knowledge of the procedures used to install, maintain, troubleshoot and replace final control elements, their accessories and components.

2013 National Occupational Analysis Reference:

- 15.01 Installs valves.
- 15.02 Maintains valves.
- 15.03 Diagnoses valves.
- 15.04 Repairs valves.
- 16.01 Installs actuators.
- 16.02 Maintains actuators.
- 16.03 Diagnoses actuators.
- 16.04 Repairs actuators.
- 17.01 Installs positioners.
- 17.02 Maintains positioners.
- 17.03 Diagnoses positioners.
- 17.04 Repairs positioners.

- 1. Define terminology associated with final control elements.
- 2. Identify hazards and describe safe work practices pertaining to final control elements.
 - i) energy state awareness
 - pressure
 - voltage
 - mechanical
 - temperature
 - ii) chemical
 - iii) isolation/lock-out/tag-out
- 3. Identify tools and equipment relating to final control elements and describe their applications and procedures for use.

- 4. Interpret codes and regulations pertaining to final control elements.
- 5. Interpret information pertaining to final control elements found on drawings, specifications and nameplates.
- 6. Identify types of final control elements and describe their components, applications and operation.
 - i) valves
 - ii) dampers/louvres
 - iii) positive displacement metering pumps
 - iv) motors
 - v) process regulators
- 7. Identify types of energy systems used to operate final control elements and describe their characteristics and applications.
 - i) hydraulic
 - ii) pneumatic
 - iii) electric
 - iv) manual operation
- 8. Identify final control element accessories and describe their components, purpose and operation.
 - i) actuators
 - hydraulic
 - pneumatic
 - electric
 - ii) boosters
 - volume
 - pressure
 - iii) positioners
 - electric
 - pneumatic
 - smart
 - iv) regulators
 - v) switches
 - vi) hand wheels
 - vii) variable speed drives (VSDs)

- 9. Describe the procedures used to select, size and install final control elements, their accessories and components.
- 10. Describe the procedures used to maintain, troubleshoot and replace final control elements, their accessories and components.

ICT-245 Alternating Current (AC) Theory

Learning Outcomes:

- Demonstrate knowledge of single-phase electricity, its characteristics and associated principles.
- Demonstrate basic knowledge of AC electrical generation, its characteristics and associated principles.
- Demonstrate knowledge of alternating current (AC) devices and their characteristics.

2013 National Occupational Analysis Reference:

- 14.01 Installs electrical and electronic equipment.
- 14.02 Maintains electrical and electronic equipment.
- 14.03 Diagnoses electrical and electronic equipment.
- 14.04 Repairs electrical and electronic equipment.

- 1. Define terminology associated with single-phase electricity.
- 2. Identify hazards and describe safe work practices pertaining to single-phase electricity.
- 3. Identify units of measure and symbols pertaining to single-phase electricity.
- 4. Explain the principles of magnetism.
- 5. Explain the principles of electromagnetism.
- 6. Explain the principles of electromagnetic induction.
- 7. Identify the types of electromagnetic induction and describe their characteristics and applications.
 - i) self-induction
 - ii) mutual induction

- 8. Explain alternating current (AC) generation.
 - i) single-phase
 - ii) three-phase
- 9. Identify types of devices used in AC generation and describe their characteristics and applications.
- 10. Identify types of transformers used in control circuitry and describe their characteristics and applications.
- 11. Identify types of AC circuits and describe their characteristics.
 - i) resistance/capacitance (RC)
 - ii) resistance/inductance (RL)
 - iii) resistance/inductance/capacitance (RLC)
- 12. Perform calculations pertaining to single-phase and basic three-phase electricity concepts.

ICT-255 Process Measurement

Learning Outcomes:

- Demonstrate knowledge of process measurement and its associated principles.
- Demonstrate knowledge of process measuring and indicating devices, their components and operation.
- Demonstrate knowledge of the procedures used to install, calibrate, configure, maintain, troubleshoot and replace process measuring and indicating devices.

2013 National Occupational Analysis Reference:

- 4.01 Installs pressure, temperature, level and flow devices.
- 4.02 Maintains pressure, temperature, level and flow devices.
- 4.03 Diagnoses pressure, temperature, level and flow devices.
- 4.04 Repairs pressure, temperature, level and flow devices.

- 1. Define terminology associated with process measurement.
- 2. Identify hazards and describe safe work practices pertaining to process measurement.
 - i) physical locations
 - ii) process conditions
 - iii) electrical
- 3. Identify tools and equipment relating to process measuring and indicating devices and describe their applications and procedures for use.
- 4. Interpret codes and regulations pertaining to process measuring and indicating devices.
- 5. Interpret information pertaining to process measuring and indicating devices found on drawings, specifications and nameplates.
- 6. Identify units of measure used to express process measurement values.
- 7. Perform conversions and calculations relating to process measurement.

- 8. Identify forms of process measurement and explain their associated principles.
 - i) pressure
 - ii) temperature
 - iii) level
 - iv) flow
- 9. Identify types of process primary elements and describe their characteristics, applications and limitations.
 - i) pressure
 - ii) temperature
 - iii) level
 - iv) flow
- 10. Explain the operation of transmitters used in conjunction with primary elements.
 - i) conventional
 - pneumatic
 - electronic
 - ii) smart
- 11. Identify types of recorders and data loggers used for process measuring and describe their characteristics and applications.
- 12. Describe the procedures used to select and install process measuring and indicating devices.
 - i) sample/tap point locations
 - ii) orientation
 - iii) environment
- 13. Describe the procedures used to calibrate and configure process measuring and indicating devices.
- 14. Describe the procedures used to maintain, troubleshoot and replace process measuring and indicating devices.

ICT-260 Hydraulic Supply Systems and Control Devices

Learning Outcomes:

- Demonstrate knowledge of hydraulic supply systems, their components and operation.
- Demonstrate knowledge of schematics, their use and interpretation.
- Demonstrate knowledge of hydraulic related calculations.
- Demonstrate knowledge of the procedures to install hydraulic control devices.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot hydraulic supply systems and components.

2013 National Occupational Analysis Reference:

- 12.01 Installs control devices for hydraulic systems.
- 12.02 Maintains control devices for hydraulic systems.
- 12.03 Diagnoses control devices and hydraulic systems.
- 12.04 Repairs control devices for hydraulic systems.

- 1. Define terminology associated with hydraulic supply systems.
- 2. Identify hazards and describe safe work practices pertaining to hydraulic supply systems.
 - i) energy state awareness
 - accumulators
 - suspended loads
 - ii) condition of hoses, piping and tubing
 - system pressure
 - system temperature
- 3. Interpret information pertaining to hydraulic supply systems found on schematics and specifications.
- 4. Identify hydraulic supply system components and describe their purpose and operation.
 - i) pumps
 - ii) motors
 - iii) actuators
 - iv) valves

- v) accumulators
- vi) control devices
- 5. Perform hydraulic calculations.
- 6. Identify types of fluids used in hydraulic supply systems and describe their characteristics and applications.
- 7. Identify tools and equipment relating to the maintenance and troubleshooting of hydraulic supply systems and describe their applications and procedures for use.
- 8. Describe the procedures used to install hydraulic control devices.
 - i) solenoids
 - ii) gauges
 - iii) switches
 - iv) actuators
- 9. Describe the procedures used to maintain and troubleshoot hydraulic supply systems and components.
 - i) check hoses, piping and tubing
 - ii) check fluids (condition and level)
 - iii) check/change filters
 - iv) determine operating parameters
 - v) adjust system pressure, temperature and flow

ICT-265 Pneumatic Supply Systems

Learning Outcomes:

- Demonstrate knowledge of pneumatic supply systems, their components and operation.
- Demonstrate knowledge of pneumatic supply system documentation and schematics, their use and interpretation.
- Demonstrate knowledge of pneumatic related calculations.
- Demonstrate knowledge of the procedures used to install, maintain, commission and troubleshoot pneumatic supply system equipment and components.

2013 National Occupational Analysis Reference:

- 13.01 Installs pneumatic equipment.
- 13.02 Maintains pneumatic equipment.
- 13.03 Diagnoses pneumatic equipment.
- 13.04 Repairs pneumatic equipment.

- 1. Define terminology associated with pneumatic supply systems.
- 2. Identify hazards and describe safe work practices pertaining to pneumatic supply systems.
 - i) energy state awareness
 - accumulators
 - suspended loads
 - ii) temperature
 - iii) pressure
 - iv) flammability/venting
- 3. Interpret information pertaining to pneumatic supply systems found on drawings and specifications.
- 4. Identify types of pneumatic supply systems and describe their applications and operation.
 - i) instrument air
 - ii) instrument gas
 - iii) service/utility air

- 5. Identify types of pneumatic supply system components and describe their purpose and operation.
 - i) compressors
 - ii) relays
 - iii) valves
 - iv) regulators
 - v) gauges
 - vi) actuators
- 6. Describe the methods of air treatment in pneumatic supply systems.
 - i) filters
 - ii) dryers
 - iii) after-coolers
 - iv) de-icers
 - v) receivers
- 7. Interpret documentation to determine the operation of pneumatic supply systems.
 - i) schematics
 - ii) manufacturers' manuals
- 8. Perform pneumatic related calculations.
 - i) unit conversion
 - ii) volume (ideal gas law)
- 9. Identify classifications and types of compressors, their specifications and applications.
 - i) dynamic/centrifugal
 - ii) positive displacement
- 10. Describe the procedures used to select, size and install pneumatic supply systems and components.
 - i) compressors
 - ii) dryers
 - iii) receivers
 - iv) piping/tubing
- 11. Identify tools and equipment relating to pneumatic supply systems and describe their applications and procedures for use.

- 12. Describe the procedures used to maintain and troubleshoot pneumatic supply systems and their components.
 - i) compressors
 - ii) lubricating fluids (condition and level)
 - iii) dryers
 - iv) de-icers
 - v) hoses, piping and tubing
 - vi) filters
- 13. Describe the procedures used to commission pneumatic supply systems and components.

ICT-270 Electronic Components (Circuits and Power Supplies)

Learning Outcomes:

- Demonstrate knowledge of AC/DC circuits and their characteristics.
- Demonstrate knowledge of electronics, their components, applications and operation.
- Demonstrate knowledge of the procedures used to install, maintain, troubleshoot and replace electronic circuits and their components.
- Demonstrate knowledge of power supplies, their components and operation.
- Demonstrate knowledge of the procedures used to install, maintain, troubleshoot, and replace power supplies.

2013 National Occupational Analysis Reference:

- 14.01 Installs electrical and electronic equipment.
- 14.02 Maintains electrical and electronic equipment.
- 14.03 Diagnoses electrical and electronic equipment.
- 14.04 Repairs electrical and electronic equipment.

- 1. Define terminology associated with electronic components.
- 2. Identify hazards and describe safe work practices pertaining to electronic components and power supplies.
 - i) energy state awareness
 - ii) static electricity discharge
- 3. Identify tools and equipment relating to electronic circuitry and describe their applications and procedures for use.
- 4. Interpret codes and regulations pertaining to electronics and power supplies.
- 5. Interpret information pertaining to electronics and power supplies found on devices, drawings and specifications.
- 6. Explain conventional current flow vs. electron flow theory in electronics.

- 7. Identify number systems used in electronics and describe their applications.
 - i) binary
 - ii) decimal
 - iii) hexadecimal
 - iv) octal
 - v) binary coded decimal (BCD)
- 8. Perform conversions between number systems.
- 9. Identify types of logic gates and describe their applications.
- 10. Identify semiconductor materials used in electronics and describe their characteristics and applications.
- 11. Identify electronic components and describe their purpose and operation in a circuit.
 - i) resistors
 - ii) capacitors
 - iii) inductors
 - iv) diodes
 - v) transistors
 - vi) op amps
 - vii) thyristors
 - viii) rectifiers
- 12. Describe the procedures used to select and install electronic circuits.
- 13. Describe the procedures used to maintain, troubleshoot and replace electronic circuitry.
- 14. Perform calculations pertaining to electronics.
 - i) power
 - ii) current
 - iii) voltage
 - iv) frequency (timing)
 - v) logic

- 15. Identify types of power supplies and describe their characteristics and operating principles.
 - i) AC/DC power supplies
 - ii) uninterruptable power supplies (UPS)
- 16. Describe the procedures used to select and install power supplies.
- 17. Describe the procedures used to maintain, troubleshoot and replace power supplies.

LEVEL 3

ICT-300 Basic Process Control

Learning Outcomes:

- Demonstrate knowledge of basic process control and its purpose.
- Demonstrate knowledge of basic process controllers, their components and operation.
- Demonstrate knowledge of the procedures used to select, install, configure, calibrate, maintain, and troubleshoot basic process controllers.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and tune basic process control systems.
- Demonstrate knowledge of the procedures used to commission basic process controllers and their systems.

2013 National Occupational Analysis Reference:

- 22.01 Determines process control strategy.
- 22.02 Optimizes process control.
- 23.01 Installs SACs.
- 23.02 Configures SACs.
- 23.03 Performs maintenance, diagnostics and repairs on SACs.

- 1. Define terminology associated with basic process control.
- 2. Identify hazards and describe safe work practices pertaining to basic process control.
- 3. Identify tools, equipment and software used to configure and calibrate process controllers and describe their applications and procedures for use.
- 4. Interpret codes and regulations pertaining to basic process control.
- 5. Interpret information pertaining to basic process control found on drawings and specifications.
 - i) ISA symbols
 - ii) SAMA symbols
 - iii) piping and instrumentation drawings (P&ID)
 - iv) loop diagrams
 - v) instrument index

- vi) schematic diagrams
- vii) wiring diagrams
- viii) control narratives (functional description)
- 6. Explain basic process control and its purpose and applications.
 - i) control variable
 - ii) manipulated variable
 - iii) manual control
 - iv) automatic control
 - v) open loop
 - vi) closed loop
- 7. Identify methods of basic process control and describe their applications.
 - i) feedback
 - ii) cascade
 - iii) auto selection (override)
- 8. Identify modes of process control and describe their characteristics, operation and combinations.
 - i) on-off (2 position control)
 - ii) proportional (P)
 - iii) integral (I)
 - iv) derivative (D)
 - v) PI, PD, PID
- 9. Explain process dynamics and their impact on process control.
- 10. Describe the procedures used to select and install process controllers.
- 11. Describe the procedures used to configure and calibrate process controllers.
- 12. Describe the procedures used to tune control loops.
 - i) closed loop methods
 - ii) open loop methods
- 13. Describe the procedures used to maintain and troubleshoot process controllers.

- 14. Describe the procedures used to maintain and troubleshoot process control loops.
- 15. Describe the procedures used to commission process controllers and their loops.

ICT-305 Trade Related Computer Use

Learning Outcomes:

- Demonstrate knowledge of trade related computer equipment and accessories and their use.
- Demonstrate knowledge of change management/management of change (MOC) requirements.

2013 National Occupational Analysis Reference:

3.03 Maintains documentation.

- 1. Define terminology associated with trade related computer use.
- 2. Identify hazards and describe safe work practices pertaining to trade related computer use.
 - i) online vs. offline applications
 - ii) hazardous locations
 - iii) administrative rights/privileges
 - iv) interfacing practices
- 3. Identify trade related computer equipment and accessories and describe their characteristics and applications.
 - i) hardware
 - ii) software/firmware
 - iii) interfacing equipment
- 4. Identify the requirements and describe the procedures used for change management/MOC.
 - i) backup/restore data
 - ii) file/document control
 - iii) equipment configuration

ICT-320 Variable Speed Drives (VSDs)

Learning Outcomes:

- Demonstrate knowledge of VSDs, their components and operation.
- Demonstrate knowledge of the procedures used to configure/calibrate, commission, maintain and troubleshoot VSDs.

2013 National Occupational Analysis Reference:

- 14.01 Installs electrical and electronic equipment.
- 14.02 Maintains electrical and electronic equipment.
- 14.03 Diagnoses electrical and electronic equipment.
- 14.04 Repairs electrical and electronic equipment.
- 18.01 Configures VSDs.
- 18.02 Maintains VSDs.
- 18.03 Diagnoses VSDs.
- 18.04 Repairs VSDs.

- 1. Define terminology associated with VSDs.
- 2. Identify hazards and describe safe work practices pertaining to VSDs.
 - i) energy state awareness
 - ii) capacitors
 - iii) electrostatic discharge
- 3. Interpret codes and regulations pertaining to VSDs.
- 4. Interpret information pertaining to VSDs found on drawings, specifications and nameplates.
- 5. Identify power degradation considerations with VSDs.
 - i) power quality/harmonics
 - ii) filters
 - iii) cable routing
 - iv) motor compatibility

- 6. Identify types of VSDs and describe their characteristics and operating principles.
 - i) AC drives
 - ii) DC drives
- 7. Identify types of motors used with VSDs and describe their characteristics and operating principles.
 - i) DC control
 - servo
 - stepping
 - ii) AC single-phase
 - iii) AC three-phase
 - iv) inverter rated
- 8. Describe the procedures used to configure/calibrate and commission VSDs.
- 9. Describe the procedures used to maintain and troubleshoot VSDs.

ICT-325 Process Analyzers I

Learning Outcomes:

- Demonstrate knowledge of process analyzers, their components and operation.
- Demonstrate knowledge of the procedures used to install, configure, calibrate, maintain, troubleshoot and replace process analyzers.
- Demonstrate knowledge of process sample systems and conditioning.

2013 National Occupational Analysis Reference:

- 6.01 Installs mass, density and consistency devices.
- 6.02 Maintains mass, density, and consistency devices
- 6.03 Diagnoses mass, density, and consistency devices.
- 6.04 Repairs mass, density and consistency devices.
- 7.01 Installs process analyzers.
- 7.02 Maintains process analyzers.
- 7.03 Diagnoses process analyzers.
- 7.04 Repairs process analyzers.

- 1. Define terminology associated with process analyzers.
- 2. Identify hazards and describe safe work practices pertaining to process analyzers.
 - i) chemical
 - ii) temperature
 - iii) pressure
 - vi) radiation
 - v) biological
- 3. Identify tools and equipment relating to process analyzers and describe their applications and procedures for use.
- 4. Interpret codes and regulations pertaining to process analyzers.
 - i) environmental regulations
 - ii) installation codes
- 5. Interpret information pertaining to process analyzers found on drawings and specifications.

- 6. Explain the principles of operation for process analyzers.
- 7. Identify types of process analyzers and describe their characteristics and applications.
 - i) pH
 - ii) oxidation reduction potential (ORP)
 - iii) conductivity
 - iv) dissolved oxygen
 - v) mass and density
 - vi) viscosity
 - vii) humidity
 - viii) turbidity
 - ix) specific ion
 - x) nuclear
 - solids composition
 - liquids composition
- 8. Identify process analyzer components and describe their purpose and operation.
- 9. Describe the procedures used to select and install process analyzers and their components.
- 10. Describe the procedures used to configure and calibrate process analyzers.
- 11. Describe the procedures used to maintain, troubleshoot and replace process analyzers and their components.
- 12. Describe process sampling and its importance to process analysis.
 - i) in situ installations
 - ii) extraction sample systems
 - iii) sample conditioning
 - temperature
 - pressure
 - filtering
- 13. Describe the procedures and equipment used to obtain and condition samples for process analysis.
ICT-330 Equipment Monitoring Devices

Learning Outcomes:

- Demonstrate knowledge of equipment monitoring and its associated principles.
- Demonstrate knowledge of equipment monitoring devices, their components and operation.
- Demonstrate knowledge of the procedures used to install, calibrate, configure, maintain, troubleshoot and replace equipment monitoring devices.

2013 National Occupational Analysis Reference:

- 5.01 Installs motion, speed, position and vibration devices.
- 5.02 Maintains motion, speed, position and vibration devices.
- 5.03 Diagnoses motion, speed, position and vibration devices.
- 5.04 Repairs motion, speed, position and vibration devices.

- 1. Define terminology associated with equipment monitoring devices.
- 2. Identify hazards and describe safe work practices pertaining to equipment monitoring devices.
- 3. Identify tools and equipment relating to equipment monitoring devices and describe their applications and procedures for use.
- 4. Interpret codes and regulations pertaining to equipment monitoring devices.
- 5. Interpret information pertaining to equipment monitoring devices found on drawings and specifications.
- 6. Identify units of measure used to express equipment monitoring values.
- 7. Perform calculations relating to equipment monitoring.
- 8. Identify types of equipment monitoring devices and describe their characteristics and applications.
 - i) vibration
 - ii) motion
 - iii) speed

- iv) position
- v) current
- vi) temperature
- 9. Describe the procedures used to select and install equipment monitoring devices.
- 10. Describe the procedures used to calibrate and configure equipment monitoring devices.
- 11. Describe the procedures used to maintain, troubleshoot and replace equipment monitoring devices.

ICT-335 Communication Systems and Devices

Learning Outcomes:

- Demonstrate knowledge of communication systems and devices, their components and operation.
- Demonstrate knowledge of the procedures used to install, configure, upgrade, maintain, troubleshoot and replace communication systems and devices.

2013 National Occupational Analysis Reference:

- 19.01 Performs installation and configuration on control network systems.
- 19.02 Diagnoses control network systems
- 19.03 Performs maintenance and repairs on control network systems.
- 19.04 Performs installation and configuration of signal converters.
- 20.01 Performs installation and configuration of signal converters.
- 20.02 Diagnoses signal converters.
- 20.03 Performs maintenance and repairs on signal converters.
- 21.01 Performs installation and configuration of gateways, bridges and media converters.
- 21.02 Diagnoses gateways, bridges and media converters.
- 21.03 Performs maintenance and repairs on gateways, bridges and media converters.

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

- 6. Identify types of communication topologies and describe their characteristics and applications.
 - i) ring
 - ii) bus
 - iii) star
 - vi) tree
 - v) mesh
- 7. Identify types of communication protocols and describe their characteristics and applications.
 - i) Fieldbus
 - ii) Profibus
 - iii) Modbus
 - iv) Transport Control Protocol/Internet Protocol (TCP/IP)
 - v) Highway Addressable Remote Transducer (HART)
 - vi) Devicenet/Controlnet
- 8. Identify types of communication standards and describe their characteristics and applications.
 - i) RS232
 - ii) RS422
 - iii) RS423
 - iv) RS485
 - v) Ethernet
 - vi) USB
- 9. Identify types of communication systems mediums and describe their characteristics and applications.
 - i) pneumatic
 - ii) wired
 - iii) fibre optic
 - iv) wireless
- 10. Identify communication systems and device components and accessories and describe their purpose and operation.
 - i) tubing
 - ii) cables
 - iii) antennas
 - iv) converters
 - v) transducers

- vi) multi-plexers
- vii) network switches/hubs
- 11. Perform conversions and calculations relating to communication systems and devices.
 - i) analogue to digital conversions
 - ii) Current to Pressure (I to P)
 - iii) decibel measurements of loss
- 12. Describe the procedures used to select and install communication systems and devices and their components.
- 13. Describe the procedures used to configure, calibrate and upgrade communication systems and devices and their components.
- 14. Describe the procedures used to maintain, troubleshoot and replace communication systems and devices and their components.
- 15. Describe the procedures to minimize electrical noise and attenuation.
 - i) grounding
 - ii) shielding
 - iii) electromagnetic compatibility (EMC)

ICT-340 Process Analyzers II

Learning Outcomes:

- Demonstrate knowledge of process analyzers, their components and operation.
- Demonstrate knowledge of the procedures used to install, configure, calibrate, maintain, troubleshoot and replace process analyzers.
- Demonstrate knowledge of process sample systems and conditioning.

National Occupational Analysis Reference:

- 6.01 Installs mass, density and consistency devices.
- 6.02 Maintains mass, density, and consistency devices.
- 6.03 Diagnoses mass, density, and consistency devices.
- 6.04 Repairs mass, density and consistency devices.
- 7.01 Installs process analyzers.
- 7.02 Maintains process analyzers.
- 7.03 Diagnoses process analyzers.
- 7.04 Repairs process analyzers.

- 1. Define terminology associated with process analyzers.
- 2. Identify hazards and describe safe work practices pertaining to process analyzers.
 - i) chemical
 - ii) temperature
 - iii) pressure
 - iv) biological
 - v) radiation
- 3. Identify tools and equipment relating to process analyzers and describe their applications and procedures for use.
- 4. Interpret codes and regulations pertaining to process analyzers.
 - i) environmental regulations
 - ii) installation codes
- 5. Interpret information pertaining to process analyzers found on drawings and specifications.

- 6. Explain the principles of operation for process analyzers.
- 7. Identify types of process analyzers and describe their characteristics and applications.
 - i) chromatography
 - ii) consistency
 - iii) spectrographic
 - iv) flue gas analyzers
 - v) environmental
 - gas
 - noise
 - fluids
 - solids
 - vi) X-ray
- 8. Identify process analyzer components and describe their purpose and operation.
- 9. Describe the procedures used to select and install process analyzers and their components.
- 10. Describe the procedures used to configure and calibrate process analyzers.
- 11. Describe the procedures used to maintain, troubleshoot and replace process analyzers and their components.
- 12. Describe process sampling and its importance to process analysis.
 - i) in situ installations
 - ii) extraction sample systems
 - iii) sample conditioning
 - temperature
 - pressure
 - filtering
- 13. Describe the procedures and equipment used to obtain and condition samples for process analysis.

ICT-345 Job Planning

Learning Outcomes:

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

2013 National Occupational Analysis Reference:

2.02 Plans tasks.

- 1. Identify sources of information relevant to job planning.
 - i) documentation
 - ii) drawings
 - iii) related professionals
 - iv) clients
- 2. Describe the considerations for determining job requirements.
 - i) personnel
 - ii) schedules
 - iii) tools and equipment
 - iv) materials/parts
 - v) permits
 - vi) safety planning
- 3. Describe the procedures used to plan job tasks.
- 4. Explain the importance of maintaining a parts inventory.
 - i) consumables
 - ii) replacement parts

LEVEL 4

ICT-410 Advanced Process Control

Learning Outcomes:

- Demonstrate knowledge of advanced process control and its purpose.
- Demonstrate knowledge of the procedures used to, configure, tune, maintain, and troubleshoot advanced process control systems.
- Demonstrate knowledge of the procedures used to commission and optimize advanced process control systems.

2013 National Occupational Analysis Reference:

- 22.01 Determines process control strategy.
- 22.02 Optimizes process control.
- 23.01 Installs SACs.
- 23.02 Configures SACs.
- 23.03 Performs maintenance, diagnostics and repairs on SACs.

- 1. Define terminology associated with advanced process control.
- 2. Identify hazards and describe safe work practices pertaining to advanced process control.
- 3. Identify tools, equipment and software used to configure and calibrate process controllers and describe their applications and procedures for use.
- 4. Interpret codes and regulations pertaining to advanced process control.
- 5. Interpret information pertaining to advanced process control found on drawings and specifications.
 - i) ISA symbols
 - ii) SAMA symbols
 - iii) piping and instrumentation drawings (P&ID)
 - iv) loop diagrams
 - v) instrument index
 - vi) schematic diagrams
 - vii) wiring diagrams
 - viii) control narratives (functional description)

- 6. Explain advanced process control and its purpose and applications.
 - i) control variable
 - ii) manipulated variable
 - iii) manual control
 - iv) automatic control
 - v) open loop
 - vi) closed loop
- 7. Identify methods of advanced process control and describe their applications.
 - i) ratio
 - ii) feed forward
 - iii) adaptive
- 8. Explain process loop interactions and their impact on process control.
- 9. Describe the procedures used to configure and tune advanced process control systems.
 - i) closed loop methods
 - ii) open loop methods
- 10. Describe the procedures used to maintain and troubleshoot advanced process control systems.
- 11. Describe the procedures used to commission and optimize advanced process control systems.

ICT-415 Supervisory Control and Data Acquisition Systems

Learning Outcomes:

- Demonstrate knowledge of supervisory control and data acquisition (SCADA) systems, their components and operation.
- Demonstrate knowledge of the procedures used to install, configure, upgrade maintain, troubleshoot, replace, backup and restore SCADA systems and components.

2013 National Occupational Analysis Reference:

- 8.01 Installs multiple variable computing devices.
- 8.02 Maintains multiple variable computing devices.
- 8.03 Diagnoses multiple variable computing devices.
- 8.04 Repairs multiple variable computing devices.
- 27.01 Installs SCADA systems.
- 27.02 Configures SCADA systems.
- 27.03 Performs maintenance, diagnosis and repairs on SCADA systems.

- 1. Define terminology associated with SCADA systems.
- 2. Identify hazards and describe safe work practices pertaining to SCADA systems.
- 3. Identify tools, equipment, and software relating to SCADA systems and describe their applications and procedures for use.
- 4. Interpret codes and regulations pertaining to SCADA systems.
- 5. Interpret information pertaining to SCADA systems found on drawings and specifications.
- 6. Identify sources of information pertaining to SCADA systems maintenance, configuration and programming.
- 7. Describe the procedures to program a SCADA system.

- 8. Identify SCADA system components and describe their purpose and operation.
 - i) hardware
 - MTU
 - RTU
 - PLC
 - HMI
 - multiple variable computing devices
 - ii) software
 - iii) communication systems and interconnected media
- 9. Describe the procedures used to select and install SCADA systems and their components.
- 10. Describe the procedures used to backup, configure, upgrade and restore SCADA systems and their components.
- 11. Describe the procedures used to maintain, troubleshoot and replace SCADA systems and their components.

ICT-420 Human Machine Interface Systems

Learning Outcomes:

- Demonstrate knowledge of human machine interface (HMI) systems, their components and operation.
- Demonstrate knowledge of the procedures used to install, configure, upgrade, maintain, troubleshoot, backup and restore HMI systems.

2013 National Occupational Analysis Reference:

- 26.01 Installs HMIs.
- 26.02 Configures HMIs.
- 26.03 Performs maintenance, diagnosis and repairs on HMIs.

- 1. Define terminology associated with HMI systems.
- 2. Identify hazards and describe safe work practices pertaining to HMI systems.
- 3. Identify tools, equipment and software relating to HMI systems and describe their applications and procedures for use.
- 4. Interpret information pertaining to HMI systems found on drawings and specifications.
- 5. Describe how HMI systems are incorporated in PLC, DCS and SCADA systems.
- 6. Identify HMI system components and describe their purpose and operation.
 - i) hardware
 - monitor
 - keyboard/mouse
 - printers/scanners
 - recorder/data loggers
 - annunciator
 - ii) software
 - engineering/design
 - operation/application

- 7. Identify types of HMI operator displays and their purpose.
 - i) overview
 - ii) group
 - iii) detail
 - iv) graphic
 - v) alarm summary
 - vi) annunciator
 - vii) trend
- 8. Describe the procedures used to select and install HMI systems and their components.
- 9. Describe the procedures used to backup, configure, upgrade and restore HMI systems and their components.
- 10. Describe the procedures used to maintain and troubleshoot HMI systems and their components.

ICT-425 Safety Systems and Devices

Learning Outcomes:

- Demonstrate knowledge of safety systems and devices, their components and operation.
- Demonstrate knowledge of the procedures used to install, maintain, troubleshoot, configure, calibrate and replace safety systems and devices and their components.
- Demonstrate knowledge of Safety Instrumented Systems (SIS) and their components.

2013 National Occupational Analysis Reference:

- 9.01 Installs safety systems and devices.
- 9.02 Maintains safety systems and devices.
- 9.03 Diagnoses safety systems and devices.
- 9.04 Repairs safety systems and devices.
- 11.01 Installs SISs.
- 11.02 Configures SISs.
- 11.03 Maintains SISs.
- 11.04 Diagnoses SISs.
- 11.05 Repairs SISs

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

- 6. Identify types of safety systems and describe their components, characteristics and applications.
 - i) safety

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- gas detection
- heat detection
- fire detection
- smoke detection
- spill detection
- water quality
- vibration
- radiation
- ii) personal protective devices
 - portable gas detectors
 - dosimeters
- iii) Safety Instrumented Systems (SIS)
 - emergency stop monitoring
 - safety sensors and devices
- iv) network security
- 7. Describe the purpose and operation of SIS systems and their components.
 - i) layers of protection analysis (LOPA)
 - ii) safety integrity level (SIL)
 - iii) safety instrumented functions (SIF)
 - iv) process control systems vs. SIS systems
- 8. Describe the procedures used to select and install safety systems and devices and their components.
- 9. Describe the procedures used to configure and calibrate safety and security systems and their components.
- 10. Describe the procedures used to maintain, troubleshoot and replace safety and security systems and their components.

ICT-435 Programmable Logic Controller Systems

Learning Outcomes:

- Demonstrate knowledge of programming languages.
- Demonstrate knowledge of programmable logic controller (PLC) systems, their components and operation.
- Demonstrate knowledge of the procedures used to install, configure, commission, maintain, troubleshoot and replace PLC systems.

2013 National Occupational Analysis Reference:

- 24.01 Installs PLCs
- 24.02 Configures PLCs.
- 24.01 Performs maintenance, diagnosis and repairs on PLCs.

- 1. Define terminology associated with PLC systems.
- 2. Identify hazards and describe safe work practices pertaining to PLCs.
 - i) online vs. offline applications
 - ii) hazardous locations
 - iii) forces, jumpers and interlocks
- 3. Interpret codes and regulations pertaining to PLCs.
- 4. Interpret information pertaining to PLC systems found on drawings and specifications.
- 5. Identify programming languages used to program PLC systems.
 - i) ladder diagram (LD)
 - ii) function block diagram (FBD)
 - iii) structured text (ST)
 - iv) instruction list (IL)
 - v) sequential function chart (SFC)
 - vi) Boolean logic diagrams
- 6. Interpret programming languages and describe their applications and the procedures used to program PLC systems.
 - i) ladder diagram (LD)

- ii) function block diagram (FBD)
- iii) sequential function chart (SFC)
- 7. Identify PLC components and systems and describe their purpose and operation.
 - i) hardware
 - ii) software
 - iii) communications
- 8. Describe the procedures used to select and install PLC systems and their components.
- 9. Describe the procedures used to configure/ program and commission PLC systems and their components.
 - i) I/O configuration
 - ii) tags, registers, data file and addressing
 - iii) user program
 - iv) communication interface
- 10. Describe the procedures used to maintain, troubleshoot and replace PLC systems and their components.

ICT-440 Distributed Control Systems

Learning Outcomes:

- Demonstrate knowledge of distributed control systems (DCSs), their components and operation.
- Demonstrate knowledge of the procedures used to install, configure, upgrade, maintain, troubleshoot, replace, backup and restore DCSs and components.

2013 National Occupational Analysis Reference:

- 25.01 Installs DCSs.
- 25.02 Configures DCSs.
- 25.03 Performs maintenance, diagnosis and repairs on DCSs.

- 1. Define terminology associated with DCSs.
- 2. Identify hazards and describe safe work practices pertaining to DCSs.
- 3. Identify tools, equipment and software relating to DCSs and describe their applications and procedures for use.
- 4. Interpret codes and regulations pertaining to DCSs.
- 5. Interpret information pertaining to DCSs found on drawings and specifications.
- 6. Identify sources of information pertaining to DCSs maintenance, configuration and programming.
- 7. Describe the procedures used to configure and program a DCS.
- 8. Identify DCS components and systems and describe their purpose and operation.
 - i) hardware
 - ii) software
 - iii) communications
- 9. Describe the procedures used to select and install DCSs and their components.

- 10. Describe the procedures used to backup, configure, upgrade and restore DCSs and their components.
- 11. Describe the procedures used to maintain, troubleshoot and replace DCSs and their components.