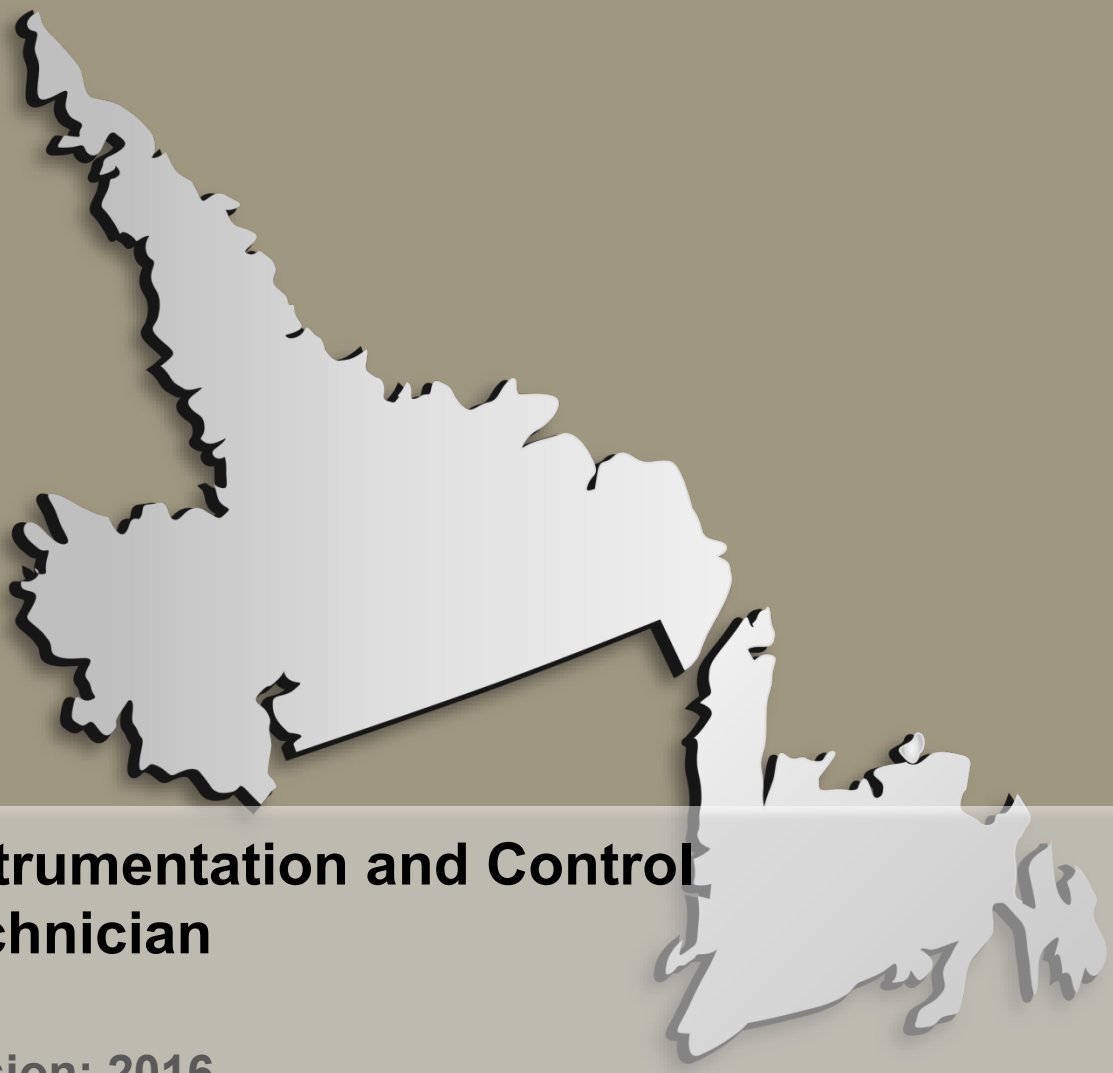
Atlantic Workforce Partnership

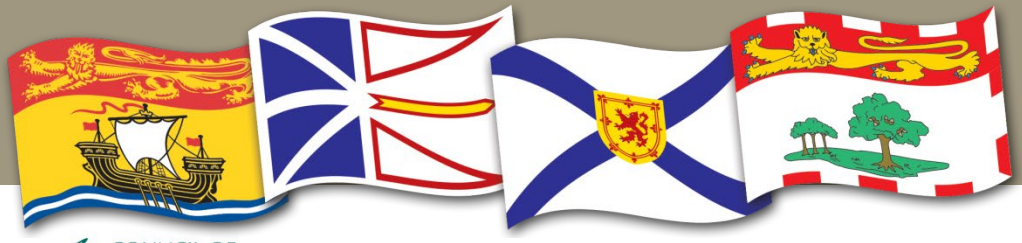
Curriculum Standard



Instrumentation and Control Technician

Version: 2016

Atlantic Apprenticeship



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

Employment and Social Development Canada
Emploi et Développement social Canada

PLAN OF TRAINING

Atlantic Apprenticeship Curriculum Standard

Instrumentation and Control Technician

March 2017

Newfoundland Labrador

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

Approved by:

Chairperson, Provincial Apprenticeship and Certification Board

Date: March 30, 2017

Atlantic Apprenticeship Curriculum Standard

Instrumentation and Control Technician

Preface

This Atlantic Apprenticeship Curriculum Standard is intended to assist instructional staff in the design and delivery of technical, in-class training in support of the Instrumentation and Control Technician program.

This document contains all the technical training elements required to complete the Instrumentation and Control Technician apprenticeship program and has been developed based on the 2013 National Occupational Analysis (NOA) and the 2015 Interprovincial Program Guide (IPG). The NOA and IPG can be found on the Red Seal website (www.red-seal.ca).

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

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

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

Granting of credit or permission to challenge level examinations for pre-employment or pre-apprenticeship training for the Instrumentation and Control Technician trade will be based on the content outlined in this standard. Training providers must contact their provincial apprenticeship authority for more information on the process and requirements for determining eligibility for credit towards an apprenticeship program. Programs which have been deemed acceptable by the jurisdictional apprenticeship authority will be identified in transfer credit matrix developed through the Atlantic Apprenticeship Harmonization Project.

Acknowledgements

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

The Atlantic Apprenticeship Council wishes to acknowledge the contributions of the following industry and instructional representatives on the Atlantic Trade Advisory Committee (ATAC) who participated in the development of this document in May 2016.

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

Table of Contents

User Guide

Atlantic Apprenticeship Curriculum Standards (AACS) are developed based on National Occupational Analyses (NOA), Interprovincial Program Guides (IPG), if available, and extensive industry consultation. This document represents the minimum content to be delivered as part of the harmonized Atlantic program for the Instrumentation and Control Technician trade.

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

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

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

Structure

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

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

Summative evaluation will be through a multiple-choice Level Examination administered through the jurisdictional Apprenticeship Authority.

User Guide *(continued)*

The 2015 National Occupational Analysis References (NOA) to AACS Comparison chart outlines the relation between each NOA sub-task and the AACS units. NOA References have also been detailed in each unit to highlight the direct link between the unit and relevant sub-tasks in the NOA.

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

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

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

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

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

Glossary of Terms

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

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

Glossary of Terms (*continued*)

SERVICE	Routine inspection and replacement of worn or deteriorating parts. An act or business function provided to a customer in the course of an individual's profession (e.g., haircut).
TECHNIQUE	Within a procedure, the manner in which technical skills are applied.
TEST	v. To subject to a procedure that ascertains effectiveness, value, proper function or other quality. n. A way of examining something to determine its characteristics or properties, or to determine whether or not it is working correctly.

Essential Skills Profiles

Through extensive research, the Government of Canada and other national and international agencies have identified and validated key essential skills for the workplace. These skills are used in nearly every job and at different levels of complexity. They provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change.

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

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

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

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

Profile Chart

LEVEL 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	
LEVEL B - PROCESS MEASURING AND INDICATING 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		
LEVEL C - SAFETY AND SECURITY SYSTEMS AND DEVICES			
ICT- 425 Safety Systems and Devices			
LEVEL D - HYDRAULIC, PNEUMATIC AND ELECTRICAL 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
ICT-320 Variable Speed Drives (VSDs)			

Profile Chart *(continued)*

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

Level Structure

Level 1 – 7 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
ICT-100	Safety	12	22
ICT-105	Tools and Equipment	12	24
ICT-110	Material Handling Equipment	6	26
ICT-115	Communication and Trade Documentation	6	27
ICT-120	Introduction to Drawings, Schematics and Specifications	12	28
ICT-125	Direct Current (DC) Theory	30	30
ICT-130	Series and Parallel Circuits	30	32
ICT-135	Voltage Drop and Power Loss	12	33
ICT-140	Conductors and Cables	18	35
ICT-145	On-off Control Devices	30	37
ICT-150	Wireways, Raceways and Fittings	12	39
ICT-155	Introduction to Pressure Measurement and Calibration	18	41
ICT-160	Tubing and Piping Systems	12	43

Level 2 – 8 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
ICT-205	Introduction to Fluids	12	46
ICT-235	Final Control Elements	42	48
ICT-245	Alternating Current (AC) Theory	30	51
ICT-255	Process Measurement	60	53
ICT-260	Hydraulic Supply Systems and Control Devices	24	55
ICT-265	Pneumatic Supply Systems	24	57
ICT-270	Electronics Components (Circuits and Power Supplies)	48	60

Level Structure (*continued*)

Level 3 – 7 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
ICT-300	Basic Process Control	54	64
ICT-305	Trade Related Computer Use	6	67
ICT-320	Variable Speed Drives (VSDs)	30	69
ICT-325	Process Analyzers I	42	71
ICT-330	Equipment Monitoring Devices	12	74
ICT-335	Communication Systems and Devices	30	76
ICT-340	Process Analyzers II	30	79
ICT-345	Job Planning	6	82

Level 4 – 7 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
ICT- 410	Advanced Process Control	36	84
ICT- 415	Supervisory Control and Data Acquisition Systems	24	86
ICT- 420	Human Machine Interface Systems	12	88
ICT- 425	Safety Systems and Devices	18	90
ICT- 435	Programmable Logic Controller Systems	60	92
ICT- 440	Distributed Control Systems	30	94
ICT- 600	Program Review	30	96

2013 NOA Sub-task to AAC Unit Comparison

NOA Sub-task		AACS Unit	
Task 1 - Performs safety-related functions.			
1.01	Maintains safe work environment.	ICT-100	Safety
1.02	Uses personal protective equipment (PPE) and safety equipment.	ICT-100	Safety
1.03	Performs de-energizing, lock-out and tag-out procedures.	ICT-100	Safety
Task 2 - Organizes work.			
2.01	Uses diagrams, drawings and schematics	ICT-120	Introduction to Drawings, Schematics and Specifications
2.02	Plans tasks	ICT-345	Job Planning
Task 3 - Performs routine trade activities.			
3.01	Maintains calibration, configuration and test equipment.	ICT-105	Tools and Equipment
3.02	Maintains tools.	ICT-105	Tools and Equipment
3.03	Maintains documentation	ICT-115	Communication and Trade Documentation
		ICT-305	Trade Related Computer Use
3.04	Operates material handling equipment.	ICT-110	Material Handling Equipment
Task 4 – Installs and services pressure, temperature, level and flow devices.			
4.01	Installs pressure, temperature, level and flow devices.	ICT-155	Introduction to Pressure Measurement and Calibration
		ICT-255	Process Measurement
4.02	Maintains pressure, temperature, level and flow devices.	ICT-155	Introduction to Pressure Measurement and Calibration
		ICT-255	Process Measurement
4.03	Diagnoses pressure, temperature, level and flow devices.	ICT-155	Introduction to Pressure Measurement and Calibration
		ICT-255	Process Measurement
4.04	Repairs pressure, temperature, level and flow devices.	ICT-155	Introduction to Pressure Measurement and Calibration
		ICT-255	Process Measurement
Task 5 - Installs and services motion, speed, position and vibration devices.			
5.01	Installs motion, speed, position and vibration devices.	ICT-330	Equipment Monitoring Devices
5.02	Maintains motion, speed, position and vibration devices.	ICT-330	Equipment Monitoring Devices

NOA Sub-task		AACS 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 - Installs and services mass, density and consistency devices.			
6.01	Installs mass, density and consistency devices.	ICT-325	Process Analyzers I
		ICT-340	Process Analyzers II
6.02	Maintains mass, density, and consistency devices.	ICT-325	Process Analyzers I
		ICT-340	Process Analyzers II
6.03	Diagnoses mass, density, and consistency devices.	ICT-325	Process Analyzers I
		ICT-340	Process Analyzers II
6.04	Repairs mass, density and consistency devices.	ICT-325	Process Analyzers I
		ICT-340	Process Analyzers II
Task 7 - Installs 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 computing devices.	ICT-415	Supervisory and Data Acquisition Systems
8.02	Maintains multiple variable computing devices.	ICT-415	Supervisory and Data Acquisition Systems
8.03	Diagnoses multiple variable computing devices.	ICT-415	Supervisory and Data Acquisition Systems
8.04	Repairs multiple variable computing devices.	ICT-415	Supervisory and Data Acquisition Systems
Task 9 - Installs and services safety systems and devices.			
9.01	Installs safety systems and devices.	ICT-425	Safety Systems and Devices
9.02	Maintains safety systems and devices.	ICT-425	Safety Systems and 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		AACS Unit	
Task 10 - Installs and services facility security systems. (NOT COMMON CORE)			
10.01	Installs facility security systems. (NOT COMMON CORE)		
10.02	Maintains facility security systems. (NOT COMMON CORE)		
10.03	Diagnoses facility security systems. (NOT COMMON CORE)		
10.04	Repairs facility security systems. (NOT COMMON CORE)		
Task 11 - Installs and services safety instrumented systems (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 - Installs and services control devices for hydraulic systems.			
12.01	Installs control devices for hydraulic systems.	ICT-160	Tubing and Piping Systems
		ICT-205	Introduction to Fluids
		ICT-260	Hydraulic Supply Systems and Control Devices
12.02	Maintains control devices for hydraulic systems.	ICT-160	Tubing and Piping Systems
		ICT-205	Introduction to Fluids
		ICT-260	Hydraulic Supply Systems and Control Devices
12.03	Diagnoses control devices and hydraulic systems.	ICT-160	Tubing and Piping Systems
		ICT-205	Introduction to Fluids
		ICT-260	Hydraulic Supply Systems and Control Devices
12.04	Repairs control devices for hydraulic systems.	ICT-160	Tubing and Piping Systems
		ICT-205	Introduction to Fluids
		ICT-260	Hydraulic Supply Systems and Control Devices
Task 13 - Installs and services pneumatic equipment.			
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

NOA Sub-task		AACS Unit	
		ICT-205	Introduction to Fluids
		ICT-265	Pneumatic Supply Systems
13.04	Repairs pneumatic equipment.	ICT-160	Tubing and Piping Systems
		ICT-205	Introduction to Fluids
		ICT-265	Pneumatic Supply Systems
Task 14 - Installs and services electrical and electronic equipment.			
14.01	Installs electrical and electronic equipment.	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-270	Electronics Components (Circuits and Power Supplies)
		ICT-245	Alternating Current (AC) Theory
		ICT-320	Variable Speed Drives (VSDs)
14.02	Maintains electrical and electronic equipment.	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-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 equipment.	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-270	Electronics Components (Circuits and Power Supplies)
		ICT-245	Alternating Current (AC) Theory

NOA Sub-task		AACS Unit	
		ICT-320	Variable Speed Drives (VSDs)
14.04	Repairs electrical and electronic equipment.	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-270	Electronics Components (Circuits and Power Supplies)
		ICT-245	Alternating Current (AC) Theory
		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 - Installs and services actuators.			
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 - Installs 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 - Configures and services variable speed drives (VSDs).			
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 configuration on control network systems.	ICT-335	Communication Systems and Devices
19.02	Diagnoses control network systems.	ICT-335	Communication Systems and Devices
19.03	Performs maintenance and repairs on control network systems.	ICT-335	Communication Systems and Devices

NOA Sub-task		AACS Unit	
Task 20 - Installs and services signal converters.			
20.01	Performs installation and configuration of signal converters.	ICT-335	Communication Systems and Devices
20.02	Diagnoses signal converters.	ICT-335	Communication Systems and Devices
20.03	Performs maintenance and repairs on signal converters.	ICT-335	Communication Systems and Devices
Task 21 - Installs and services gateways, bridges and media converters.			
21.01	Performs installation and configuration of gateways, bridges and media converters.	ICT-335	Communication Systems and Devices
21.02	Diagnoses gateways, bridges and media converters.	ICT-335	Communication Systems and Devices
21.03	Performs maintenance and repairs on gateways, bridges and media converters.	ICT-335	Communication Systems and Devices
Task 22 - Establishes and optimizes process control strategies.			
22.01	Determines process control strategy.	ICT-300	Basic Process Control
		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 and repairs on SACs.	ICT-300	Basic Process Control
		ICT-410	Advanced Process Control
Task 24 - Installs and services programmable logic controllers (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 and repairs on PLCs.	ICT-435	Programmable Logic Controller Systems
Task 25 - Installs and services distributed control systems (DCSs).			
25.01	Installs DCSs.	ICT-440	Distributed Control Systems
25.02	Configures DCSs.	ICT-440	Distributed Control Systems
25.03	Performs maintenance, diagnosis and repairs on DCSs.	ICT-440	Distributed Control Systems
Task 26 - Installs and services human machine interface (HMI).			

NOA Sub-task		AACS Unit	
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 and repairs on HMIs.	ICT-420	Human Machine Interface Systems
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 and repairs on SCADA systems.	ICT-415	Supervisory Control and Data 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.

Suggested Hours:

12 Hours

Objectives and Content:

Theoretical Objectives

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

Practical Objectives

N/A

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.

Suggested Hours:

12 Hours

Objectives and Content:

Theoretical Objectives

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 and their care.

8. Identify types of installation and mounting hardware and describe their applications.

Practical Objectives

N/A

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.

Suggested Hours:

6 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

N/A

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.

Suggested Hours:

6 Hours

Objectives and Content:

Theoretical Objectives

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

Practical Objectives

N/A

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.

Suggested Hours:

12 Hours

Objectives and Content:

Theoretical Objectives

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

Practical Objectives

N/A

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.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with DC electricity.

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

3. Explain 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.

Practical Objectives

1. Use multi-meters to measure DC components and circuits.

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.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

1. Use multi-meters to measure 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.

Suggested Hours:

12 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with voltage drop and power loss.

2. 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.

Practical Objectives

N/A

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.

Suggested Hours:

18 Hours

Objectives and Content:

Theoretical Objectives

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.
   i) fuses
   ii) circuit breakers

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

Practical Objectives

N/A

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.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

1. Troubleshoot 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.

Suggested Hours:

12 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

N/A

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.

Suggested Hours:

18 Hours

Objectives and Content:

Theoretical Objectives

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. Describe the procedures used to maintain and troubleshoot basic pressure measurement devices.

Practical Objectives

1. Calibrate 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.

Suggested Hours:

12 Hours

Objectives and Content:

Theoretical Objectives

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. Describe the procedures used to maintain and troubleshoot tubing and piping systems and components.

Practical Objectives

1. Perform tube bending, installation and pressure test.

2. Cut, thread and ream rigid pipe.

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.

Suggested Hours:

12 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

N/A

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.

Suggested Hours:

42 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

1. Disassemble and assemble a control valve.
2. Install a positioner.

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.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with single-phase electricity.

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

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

4. Explain the principles of magnetism.

5. Explain the principles of electromagnetism.

6. Explain the principles of electromagnetic induction.

7. Identify the types of electromagnetic induction and describe their characteristics and applications.

i) self-induction
ii) mutual induction

8. Explain alternating current (AC) 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.

Practical Objectives

1. Use multi-meters to measure AC components and circuits.

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.

Suggested Hours:

60 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

1. Test, diagnose, and calibrate process measurement 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.

Suggested Hours:

24 Hours

Objectives and Content:

Theoretical Objectives

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

Practical Objectives

N/A

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.

Suggested Hours:

24 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

N/A

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.

Suggested Hours:

48 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

N/A

Level 3

Unit Code	Title	Hours	Page
ICT-300	Basic Process Control	54	64
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ICT-320	Variable Speed Drives (VSDs)	30	69
ICT-325	Process Analyzers I	42	71
ICT-330	Equipment Monitoring Devices	12	74
ICT-335	Communication Systems and Devices	30	76
ICT-340	Process Analyzers II	30	79
ICT-345	Job Planning	6	82

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.

Suggested Hours:

54 Hours

Objectives and Content:

Theoretical Objectives

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)
   iv) split ranging

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.

Practical Objectives

1. Loop tune a controller.

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.

Suggested Hours:

6 Hours

Objectives and Content:

Theoretical Objectives

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

Practical Objectives

N/A

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.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

1. Configure a Variable speed drive (VSD).

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.

Suggested Hours:

42 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

1. Configure and calibrate process analyzers.

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.

Suggested Hours:

12 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

N/A

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.
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.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

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
   vii) BACnet

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)

Practical Objectives

N/A

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.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

N/A

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.

Suggested Hours:

6 Hours

Objectives and Content:

Theoretical Objectives

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

Practical Objectives

N/A

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.

Suggested Hours:

39 Hours

Objectives and Content:

Theoretical Objectives

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.
   i) boiler control systems

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.

Practical Objectives

N/A

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.

Suggested Hours:

27 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

N/A

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.

Suggested Hours:

15 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

N/A

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

Suggested Hours:

21 Hours

Objectives and Content:

Theoretical Objectives

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
      - 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.

Practical Objectives

N/A

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.
24.03 Performs maintenance, diagnosis and repairs on PLCs.

Suggested Hours:

54 Hours

Objectives and Content:

Theoretical Objectives

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.

Practical Objectives

1. Configure, program and run a PLC.

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.

Suggested Hours:

27 Hours

Objectives and Content:

Theoretical Objectives

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 DCS~~s~~ 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.

Practical Objectives

N/A

ICT-600 Program Review

Learning Outcomes:

- Demonstrate knowledge of the National Occupational Analysis and its relationship to the Interprovincial Examination.
- Demonstrate knowledge of overall comprehension of the trade in preparation for the Interprovincial Examination.

2013 National Occupational Analysis:

Entire National Occupational Analysis (NOA)

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with an NOA.
   i) blocks
   ii) tasks
   iii) sub-tasks

2. Explain how an NOA is developed and the link it has with the Interprovincial Red Seal Examination.
   i) development
   ii) validation
   iii) block and task weighting
   iv) examination breakdown (pie-chart)

3. Identify Red Seal products and describe their use for preparing for the Interprovincial Red Seal Examination.
   i) Red Seal website
   ii) examination preparation guide
   iii) sample questions
   iv) examination counselling sheets

4. Explain the relationship between the NOA and the AACS and IPG.

5. Review Common Occupational Skills for the ICT trade as identified in the NOA.
   i) safety related activities
   ii) organizes work
   iii) routine trade activities

6. Review Process Measuring and Indicating Devices for the ICT trade as identified in the NOA.
   i) pressure, temperature, level and flow
   ii) motion, speed, position and vibration
   iii) mass, density and consistency
   iv) process analyzers
   v) multiple variable computing

7. Review Safety and Security Systems and Devices for the ICT trade as identified in the NOA.
   i) safety systems
   ii) safety instrumented systems (SIS)

8. Review Hydraulic, Pneumatic and Electrical Systems for the ICT trade as identified in the NOA.
   i) hydraulic control devices
   ii) pneumatic equipment
   iii) electrical and electronic equipment

9. Review Final Control Devices for the ICT trade as identified in the NOA.
   i) valves
   ii) actuators
   iii) positioners
   iv) variable speed drives (VSDs)

10. Review Communication Systems and Devices for the ICT trade as identified in the NOA.
   i) control network systems
   ii) signal converters
   iii) gateways, bridges and media converters

11. Review Control Systems and Process Control for the ICT trade as identified in the NOA.
    i) process control strategies
    ii) stand-alone controllers (SACs)
    iii) programmable logic controllers (PLCs)
    iv) distributed control systems (DCSs)
    v) human machine interfaces (HMIs)
    vi) supervisory control and data acquisition (SCADA)

Practical Objectives

N/A

Feedback and Revisions

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

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Any comments or suggestions received will be reviewed and considered to determine the course of action required. If the changes are deemed to be minor, they will be held for implementation during the next review cycle. If immediate change is deemed appropriate and approved by the Atlantic Trade Advisory Committee, it will result in a revision to this version of the AACS and will be detailed in the following section.

Version Changes

Revision Date	Section	Description of Change