

# INSTRUMENTATION AND CONTROL TECHNICIAN

2017

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



# Atlantic Apprenticeship Curriculum Standard

## Instrumentation and Control Technician

## Preface

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This Atlantic Apprenticeship Curriculum Standard is intended to assist instructional staff in the design and delivery of technical, in-class training in support of the 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](http://www.red-seal.ca)).

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

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

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

Granting of credit or permission to challenge level examinations for pre-employment or pre-apprenticeship training for the 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

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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.

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## User Guide

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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)*

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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**

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

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



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

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

## Essential Skills Profiles

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

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

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

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

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

## Profile Chart

<b>LEVEL A - COMMON OCCUPATIONAL SKILLS</b>			
ICT-100 Safety	ICT-105 Tools and Equipment	ICT-110 Material Handling Equipment	ICT-115 Trade Documentation
ICT-120 Introduction to Drawings, Schematics and Specifications	ICT-305 Trade Related Computer Use	ICT-345 Job Planning	
<b>LEVEL B - PROCESS MEASURING AND INDICATING DEVICES</b>			
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		
<b>LEVEL C - SAFETY AND SECURITY SYSTEMS AND DEVICES</b>			
ICT- 425 Safety Systems and Devices			
<b>LEVEL D - HYDRAULIC, PNEUMATIC AND ELECTRICAL SYSTEMS</b>			
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		

## Recommended Atlantic Level Structure

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### Level 1 - 7 Weeks

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
MENT-700	Mentoring I	6	20	N/A
ICT-100	Safety	9	22	N/A
ICT-105	Tools and Equipment	12	24	N/A
ICT-110	Material Handling Equipment	6	26	N/A
ICT-115	Trade Documentation	3	27	N/A
ICT-120	Introduction to Drawings, Schematics and Specifications	12	28	N/A
ICT-125	Direct Current (DC) Theory	30	30	Use multi-meters to measure DC components and circuits.
ICT-130	Series and Parallel Circuits	30	32	Use multi-meters to measure series, parallel and complex circuits.
ICT-135	Voltage Drop and Power Loss	12	33	N/A
ICT-140	Conductors and Cables	18	35	N/A
ICT-145	On-off Control Devices	30	37	Troubleshoot on/off control devices.
ICT-150	Wireways, Raceways and Fittings	12	39	N/A
ICT-155	Introduction to Pressure Measurement and Calibration	18	41	Calibrate basic pressure measurement devices.
ICT-160	Tubing and Piping Systems	12	43	1. Perform tube bending, installation and pressure test. 2. Cut, thread and ream rigid pipe.

### Level 2 - 8 Weeks

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
ICT-205	Introduction to Fluids	12	46	N/A
ICT-235	Final Control Elements	42	48	1. Disassemble and assemble a control valve. 2. Install a positioner.
ICT-245	Alternating Current (AC) Theory	30	51	Use multi-meters to measure AC components and circuits.
ICT-255	Process Measurement	60	53	Test, diagnose, and calibrate process measurement devices.
ICT-260	Hydraulic Supply Systems and Control Devices	24	55	N/A
ICT-265	Pneumatic Supply Systems	24	57	N/A
ICT-270	Electronics Components (Circuits and Power Supplies)	48	60	N/A

## Recommended Atlantic Level Structure

### Level 3 - 7 Weeks

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
ICT-300	Basic Process Control	54	64	Loop tune a controller.
ICT-305	Trade Related Computer Use	6	67	N/A
ICT-320	Variable Speed Drives (VSDs)	30	69	Configure a Variable speed drive (VSD).
ICT-325	Process Analyzers I	42	71	Configure and calibrate process analyzers.
ICT-330	Equipment Monitoring Devices	12	74	N/A
ICT-335	Communication Systems and Devices	30	76	N/A
ICT-340	Process Analyzers II	30	79	N/A
ICT-345	Job Planning	6	82	N/A

### Level 4 - 7 Weeks

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
ICT- 410	Advanced Process Control	30	84	N/A
ICT- 415	Supervisory Control and Data Acquisition Systems	24	86	N/A
ICT- 420	Human Machine Interface Systems	12	88	N/A
ICT- 425	Safety Systems and Devices	18	90	N/A
ICT- 435	Programmable Logic Controller Systems	60	92	Configure, program and run a PLC.
ICT- 440	Distributed Control Systems	30	94	N/A
MENT-701	Mentoring II	6	96	N/A
ICT- 600	Program Review	30	97	N/A

**\*Suggested Hours:** The time it should take to cover the unit (a guide only).

**\*Practical Objectives:** The tasks/skills apprentices must be exposed to during technical training. An individual or group performance of the task/skill is recommended; if not possible, an instructor demonstration is acceptable. Training Providers should use practical, hands-on learning whenever possible, whether identified in the curriculum as a practical objective or not.

## 2013 NOA Sub-task to AAC Unit Comparison

NOA Sub-task		AAC Unit	
<b>Task 1 - Performs safety-related functions.</b>			
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
<b>Task 2 - Organizes work.</b>			
2.01	Uses diagrams, drawings and schematics	ICT-120	Introduction to Drawings, Schematics and Specifications
2.02	Plans tasks	ICT-345	Job Planning
<b>Task 3 - Performs routine trade activities.</b>			
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	Trade Documentation
		ICT-305	Trade Related Computer Use
3.04	Operates material handling equipment.	ICT-110	Material Handling Equipment
<b>Task 4 - Installs and services pressure, temperature, level and flow devices.</b>			
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
<b>Task 5 - Installs and services motion, speed, position and vibration devices.</b>			
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
<b>Task 6 - Installs and services mass, density and consistency devices.</b>			
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
<b>Task 7 - Installs and services process analyzers.</b>			
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
<b>Task 8 - Installs and services multiple variable computing devices.</b>			
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
<b>Task 9 - Installs and services safety systems and devices.</b>			
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
<b>Task 10 - Installs and services facility security systems. (NOT COMMON CORE)</b>			
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)		



NOA Sub-task		AACS Unit	
<b>Task 11 - Installs and services safety instrumented systems (SISs).</b>			
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
<b>Task 12 - Installs and services control devices for hydraulic systems.</b>			
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
<b>Task 13 - Installs and services pneumatic equipment.</b>			
13.01	Installs pneumatic equipment.	ICT-160	Tubing and Piping Systems
		ICT-205	Introduction to Fluids
		ICT-265	Pneumatic Supply Systems
13.02	Maintains pneumatic equipment.	ICT-160	Tubing and Piping Systems
		ICT-205	Introduction to Fluids
		ICT-265	Pneumatic Supply Systems
13.03	Diagnoses pneumatic equipment.	ICT-160	Tubing and Piping Systems
		ICT-205	Introduction to Fluids
		ICT-265	Pneumatic Supply Systems
13.04	Repairs pneumatic equipment.	ICT-160	Tubing and Piping Systems
		ICT-205	Introduction to Fluids
		ICT-265	Pneumatic Supply Systems
<b>Task 14 - Installs and services electrical and electronic equipment.</b>			
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

NOA Sub-task		AACS Unit	
		ICT-145	On-Off Control Devices
		ICT-150	Wireways, Raceways & 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 & 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 & Fittings
		ICT-270	Electronics Components (Circuits and Power Supplies)
		ICT-245	Alternating Current (AC) Theory
		ICT-320	Variable Speed Drives (VSDs)
14.04	Repairs electrical and electronic 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 & Fittings
		ICT-270	Electronics Components (Circuits and Power Supplies)
		ICT-245	Alternating Current (AC) Theory
		ICT-320	Variable Speed Drives (VSDs)
<b>Task 15 - Installs and services valves.</b>			
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

NOA Sub-task		AACS Unit	
15.03	Repairs valves.	ICT-235	Final Control Elements
<b>Task 16 - Installs and services actuators.</b>			
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
<b>Task 17 - Installs and services positioners.</b>			
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
<b>Task 18 - Configures and services variable speed drives (VSDs).</b>			
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)
<b>Task 19 - Installs and services control network systems.</b>			
19.01	Performs installation & config on control network systems.	ICT-335	Communication Systems and Devices
19.02	Diagnoses control network systems.	ICT-335	Communication Sys & Devices
19.03	Performs maintenance and repairs on control network systems.	ICT-335	Communication Systems and Devices
<b>Task 20 - Installs and services signal converters.</b>			
20.01	Performs installation and configuration of signal converters.	ICT-335	Communication Systems and Devices
20.02	Diagnoses signal converters.	ICT-335	Communication Systems & Devices
20.03	Performs maintenance and repairs on signal converters.	ICT-335	Communication Systems & Devices
<b>Task 21 - Installs and services gateways, bridges and media converters.</b>			
21.01	Performs installation and configuration of gateways, bridges & 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
<b>Task 22 - Establishes and optimizes process control strategies.</b>			
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

NOA Sub-task		AACS Unit	
<b>Task 23 - Installs and services stand-alone controllers (SACs).</b>			
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
<b>Task 24 - Installs and services programmable logic controllers (PLCs).</b>			
24.01	Installs PLCs.	ICT-435	Programmable Logic Controller Sys
24.02	Configures PLCs.	ICT-435	Programmable Logic Controller Sys
24.03	Performs maintenance, diagnosis and repairs on PLCs.	ICT-435	Programmable Logic Controller Sys
<b>Task 25 - Installs and services distributed control systems (DCSs).</b>			
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
<b>Task 26 - Installs and services human machine interface (HMI).</b>			
26.01	Installs HMIs.	ICT-420	Human Machine Interface Sys
26.02	Configures HMIs.	ICT-420	Human Machine Interface Sys
26.03	Performs maintenance, diagnosis and repairs on HMIs.	ICT-420	Human Machine Interface Sys
<b>Task 27 - Installs and services Supervisory Control and Data Acquisition (SCADA) systems.</b>			
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

Unit Code	Title	Hours	Page
MENT-700	Mentoring I	6	20
ICT-100	Safety	9	22
ICT-105	Tools and Equipment	12	24
ICT-110	Material Handling Equipment	6	26
ICT-115	Trade Documentation	3	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

## **MENT-700          Mentoring I**

### **Learning Outcomes:**

- Demonstrate knowledge of effective communication practices as a learner.
- Demonstrate knowledge of strategies for learning skills in the workplace.

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

4.01 Uses communication techniques

4.02 Uses mentoring techniques

### **Suggested Hours:**

6 hours

### **Theoretical Objectives:**

1. Describe the importance of one's own individual experiences.
2. Identify behaviours that demonstrate positive learning experiences.
3. Identify the benefits of workplace mentoring for the apprentice, mentor, and employer.
4. Identify the partners involved in apprenticeship training.
5. Describe the shared responsibilities for workplace learning in apprenticeship.
6. Identify different learning needs and strategies to address challenges or barriers in the workplace.
  - i) learning disabilities
  - ii) language
  - iii) underrepresentation
7. Identify the components that create a positive and inclusive workplace culture.
  - i) workplace characteristics
  - ii) individual behaviours
8. Identify various learning styles and determine one's own learning preferences.
9. Explain how learning preferences impact learning new skills.

10. Identify different learning strategies to meet individual learning needs.
11. Describe the importance of adapting to a variety of teaching and learning methods in the workplace.
12. Identify techniques for effective communication as a learner.
  - i) verbal and non-verbal
  - ii) active listening
13. Identify and describe personal responsibilities and attitudes that contribute to on-the-job success.
  - i) self advocating
  - ii) asking questions
  - iii) accepting constructive feedback
  - iv) working safely
  - v) employing time management techniques and being punctual

**Practical Objectives:**

N/A

## 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:

- 1.1 Maintains safe work environment.
- 1.2 Uses personal protective equipment (PPE) and safety equipment.
- 1.3 Performs de-energizing, lock-out and tag-out procedures.

### Suggested Hours:

9 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:

- 3.1 Maintains calibration, configuration and test equipment.
- 3.2 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            Trade Documentation

### Learning Outcomes:

- Demonstrate knowledge of trade related documentation and its use.

### 2013 National Occupational Analysis Reference:

3.03 Maintains documentation.

### Suggested Hours:

3 Hours

### Objectives and Content:

#### Theoretical Objectives

1. 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

**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:**

- 14.1 Installs electrical and electronic equipment.
- 14.2 Maintains electrical and electronic equipment.
- 14.3 Diagnoses electrical and electronic equipment.
- 14.4 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:

- 14.1 Installs electrical and electronic equipment.
- 14.2 Maintains electrical and electronic equipment.
- 14.3 Diagnoses electrical and electronic equipment.
- 14.4 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.

**Learning Outcomes:**

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

**2013 National Occupational Analysis Reference:**

- 14.1 Installs electrical and electronic equipment.
- 14.2 Maintains electrical and electronic equipment.
- 14.3 Diagnoses electrical and electronic equipment.
- 14.4 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:

- 14.1 Installs electrical and electronic equipment.
- 14.2 Maintains electrical and electronic equipment.
- 14.3 Diagnoses electrical and electronic equipment.
- 14.4 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

**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:**

- 14.1 Installs electrical and electronic equipment.
- 14.2 Maintains electrical and electronic equipment.
- 14.3 Diagnoses electrical and electronic equipment.
- 14.4 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.



**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:**

- 14.1 Installs electrical and electronic equipment.
- 14.2 Maintains electrical and electronic equipment.
- 14.3 Diagnoses electrical and electronic equipment.
- 14.4 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

**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:**

- 4.1 Installs pressure, temperature, level and flow devices.
- 4.2 Maintains pressure, temperature, level and flow devices.
- 4.3 Diagnoses pressure, temperature, level and flow devices.
- 4.4 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.

**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:**

- 12.1 Installs control devices for hydraulic systems.
- 12.2 Maintains control devices for hydraulic systems.
- 12.3 Diagnoses control devices for hydraulic systems.
- 12.4 Repairs control devices for hydraulic systems.
- 13.1 Installs pneumatic equipment.
- 13.2 Maintains pneumatic equipment.
- 13.3 Diagnoses pneumatic equipment.
- 13.4 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

Unit Code	Title	Hours	Page
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

**Learning Outcomes:**

- Demonstrate knowledge of the principles and applications of fluids.

**2013 National Occupational Analysis Reference:**

- 12.1 Installs control devices for hydraulic systems.
- 12.2 Maintains control devices for hydraulic systems.
- 12.3 Diagnoses control devices for hydraulic systems.
- 12.4 Repairs control devices for hydraulic systems.
- 13.1 Installs pneumatic equipment.
- 13.2 Maintains pneumatic equipment.
- 13.3 Diagnoses pneumatic equipment.
- 13.4 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

**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:**

- 15.1 Installs valves.
- 15.2 Maintains valves.
- 15.3 Diagnoses valves.
- 15.4 Repairs valves.
- 16.1 Installs actuators.
- 16.2 Maintains actuators.
- 16.3 Diagnoses actuators.
- 16.4 Repairs actuators.
- 17.1 Installs positioners.
- 17.2 Maintains positioners.
- 17.3 Diagnoses positioners.
- 17.4 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.

**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:**

- 14.1 Installs electrical and electronic equipment.
- 14.2 Maintains electrical and electronic equipment.
- 14.3 Diagnoses electrical and electronic equipment.
- 14.4 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.

**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:**

- 4.1 Installs pressure, temperature, level and flow devices.
- 4.2 Maintains pressure, temperature, level and flow devices.
- 4.3 Diagnoses pressure, temperature, level and flow devices.
- 4.4 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.



**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:**

- 12.1 Installs control devices for hydraulic systems.
- 12.2 Maintains control devices for hydraulic systems.
- 12.3 Diagnoses control devices and hydraulic systems.
- 12.4 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

**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:**

- 13.1 Installs pneumatic equipment.
- 13.2 Maintains pneumatic equipment.
- 13.3 Diagnoses pneumatic equipment.
- 13.4 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

**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:**

- 14.1 Installs electrical and electronic equipment.
- 14.2 Maintains electrical and electronic equipment.
- 14.3 Diagnoses electrical and electronic equipment.
- 14.4 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
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

## 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:**

- 22.1 Determines process control strategy.
- 22.2 Optimizes process control.
- 23.1 Installs SACs.
- 23.2 Configures SACs.
- 23.3 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:

- 14.1 Installs electrical and electronic equipment.
- 14.2 Maintains electrical and electronic equipment.
- 14.3 Diagnoses electrical and electronic equipment.
- 14.4 Repairs electrical and electronic equipment.
- 18.1 Configures VSDs.
- 18.2 Maintains VSDs.
- 18.3 Diagnoses VSDs.
- 18.4 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:

- 6.1 Installs mass, density and consistency devices.
- 6.2 Maintains mass, density, and consistency devices
- 6.3 Diagnoses mass, density, and consistency devices.
- 6.4 Repairs mass, density and consistency devices.
- 7.1 Installs process analyzers.
- 7.2 Maintains process analyzers.
- 7.3 Diagnoses process analyzers.
- 7.4 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:

- 5.1 Installs motion, speed, position and vibration devices.
- 5.2 Maintains motion, speed, position and vibration devices.
- 5.3 Diagnoses motion, speed, position and vibration devices.
- 5.4 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:

- 19.1 Performs installation and configuration on control network systems.
- 19.2 Diagnoses control network systems
- 19.3 Performs maintenance and repairs on control network systems.
- 20.1 Performs installation and configuration of signal converters.
- 20.2 Diagnoses signal converters.
- 20.3 Performs maintenance and repairs on signal converters.
- 21.1 Performs installation and configuration of gateways, bridges and media converters.
- 21.2 Diagnoses gateways, bridges and media converters.
- 21.3 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:

- 6.1 Installs mass, density and consistency devices.
- 6.2 Maintains mass, density, and consistency devices.
- 6.3 Diagnoses mass, density, and consistency devices.
- 6.4 Repairs mass, density and consistency devices.
- 7.1 Installs process analyzers.
- 7.2 Maintains process analyzers.
- 7.3 Diagnoses process analyzers.
- 7.4 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

<b>Unit Code</b>	<b>Title</b>	<b>Hours</b>	<b>Page</b>
ICT-410	Advanced Process Control	30	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
MENT-701	Mentoring II	6	96
ICT-600	Program Review	30	98

## 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:**

- 22.1 Determines process control strategy.
- 22.2 Optimizes process control.
- 23.1 Installs SACs.
- 23.2 Configures SACs.
- 23.3 Performs maintenance, diagnostics and repairs on SACs.

### **Suggested Hours:**

30 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:

- 8.1     Installs multiple variable computing devices.
- 8.2     Maintains multiple variable computing devices.
- 8.3     Diagnoses multiple variable computing devices.
- 8.4     Repairs multiple variable computing devices.
- 27.1    Installs SCADA systems.
- 27.2    Configures SCADA systems.
- 27.3    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:

- 26.1 Installs HMIs.
- 26.2 Configures HMIs.
- 26.3 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:

- 9.1    Installs safety systems and devices.
- 9.2    Maintains safety systems and devices.
- 9.3    Diagnoses safety systems and devices.
- 9.4    Repairs safety systems and devices.
- 11.1   Installs SISs.
- 11.2   Configures SISs.
- 11.3   Maintains SISs.
- 11.4   Diagnoses SISs.
- 11.5   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:

- 24.1 Installs PLCs
- 24.2 Configures PLCs.
- 24.3 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:

- 25.1    Installs DCSs.
- 25.2    Configures DCSs.
- 25.3    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 DCSs-maintenance, configuration and programming.
7.     Describe the procedures used to configure and program a DCS.



8. Identify DCS components and systems and describe their purpose and operation.
  - i) hardware
  - ii) software
  - iii) communications
9. Describe the procedures used to select and install DCSs and their components.
10. Describe the procedures used to backup, configure, upgrade and restore DCSs and their components.
11. Describe the procedures used to maintain, troubleshoot and replace DCSs and their components.

Practical Objectives

N/A

**Learning Outcomes:**

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

**Red Seal Occupational Standard Reference:**

4.01 Uses communication techniques

4.02 Uses mentoring techniques

**Suggested Hours:**

6 hours

**Theoretical Objectives:**

1. Identify the different roles played by a workplace mentor.
2. Identify strategies to create a supportive learning environment.
3. Identify techniques for effective communication as a mentor.
  - i) constructive feedback
  - ii) active listening
  - iii) leading meetings and one-on-one sessions
4. Describe the steps in teaching a skill.
  - i) identifying the point of lesson
  - ii) linking the lesson
  - iii) demonstrating the skill
  - iv) providing practice
  - v) giving feedback
  - vi) assessing skill and progress
5. Identify strategies to assist in teaching a skill while meeting individual learning needs.
  - i) principles of instruction
  - ii) coaching skills
6. Explain how to adjust a lesson for various situations.

**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

#### **Suggested Learning Activities:**

1. Conduct a mock certification exam to be used for diagnostic purposes.
2. Review the National Occupational Analysis.
3. Review the Apprentice Logbook.
4. Review the Exam Preparation information found on <https://www.nsapprenticeship.ca/>
5. Conduct a final mock certification exam.

#### **Resources:**

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

- Exam Preparation information, including occupational analyses, exam counseling sheets, practice exams and sample questions, and other study materials and resources, can be found on <https://www.nsapprenticeship.ca/>
- Apprentice's personal logbook
- Applicable codes and regulations
- Program texts

**Evaluation:** pass/fail

## Feedback and Revisions

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

**New Brunswick:**

Apprenticeship and Occupational  
Certification  
Post-Secondary Education, Training and  
Labour  
470 York St., Rm. 110, PO Box 6000  
Fredericton, NB E3B 5H1  
Tel: 506-453-2260  
Toll Free in NB: 1-855-453-2260  
[www.gnb.ca](http://www.gnb.ca)

**Prince Edward Island:**

Apprenticeship, Training and  
Certification  
Atlantic Technology Centre  
212-176 Great George St.,  
PO Box 2000  
Charlottetown, PE C1A 7N8  
Tel: 902-368-4460  
[www.apprenticeship.pe.ca](http://www.apprenticeship.pe.ca)

**Newfoundland and Labrador:**

Apprenticeship and Trades Certification  
Immigration, Population Growth & Skills  
Confederation Bldg., West Block  
Prince Philip Dr., PO Box 8700  
St. John's, NL A1B 4J6  
Toll Free: 877-771-3737  
[www.gov.nl.ca/atcd](http://www.gov.nl.ca/atcd)

**Nova Scotia:**

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

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

**Version Changes**

Revision Date	Section	Description of Change
May 2024	Levels 1 and 4	Integration of MENT-700 Mentoring I and MENT-701 Mentoring II