
Plan of Training

Process Operator



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

December 2012

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Approved by:

A handwritten signature in black ink, appearing to read "Paul Boyd", with a horizontal line extending to the right.

Chairperson, Provincial Apprenticeship and Certification Board

Date: December 11, 2012

Preface

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

Acknowledgements

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

We offer you a sincere thank you.

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Table of Contents

A	Program Structure	4
	BLOCK I	8
	TS1510 Occupational Health and Safety	8
	TS1520 Workplace Hazardous Materials Information System (WHMIS)	11
	TS1530 Standard First Aid	14
	OR1100 Safety	15
	OR1110 Environmental Protection Awareness.....	17
	LA1110 Fall Protection Awareness.....	19
	LA1100 Confined Space Awareness.....	21
	OR1150 Hoisting, Lifting and Rigging.....	23
	OR1160 Tools and Equipment.....	26
	OR1170 Piping and Instrumentation Drawings	28
	PH1020 Physics.....	29
	OR1200 Electrical Fundamentals	36
	CH1020 Chemistry	39
	OR1210 Process Measurement	49
	OR1220 Process Analyzers.....	51
	OR1230 Final Control Elements	54
	OR1300 Basic Process Control.....	56
	OR1311 HMI and Process Control Systems.....	59
	OR1320 Pumps.....	61
	OR1330 Introduction to Process Operations	63
	AP1101 Introduction to Apprenticeship.....	66
	AM1100 Math Essentials	70
	AM1280 Process Math Fundamentals	72
	CM2160 Communication Essentials.....	74
	SD1760 Workplace Essentials	77
	MC1060 Computer Essentials	80
	BLOCK II Hydrometallurgical Refining.....	83
	OR2100 Introduction to the Hydrometallurgical Process	83
	OR2110 Feed Preparation and Handling	85
	OR2120 Neutralization	86
	OR2200 Pressure Oxidative Leaching	88
	OR2210 Solvent Extraction and Cadmium Removal	90
	OR2220 Electrowinning.....	92
	OR2230 Water, Effluent and Residue Treatment.....	94

BLOCK II	Mineral Processing-	96
OR2300	Mineral Processing I	96
OR2310	Mineral Processing II	99
OR2320	Mineral Processing III	101
BLOCK III	Common Advanced Courses	105
OR2400	Advanced Control Systems	105
OR2410	Advanced Process Control	108
OR2420	Troubleshooting Techniques	110
OR2440	Work Planning	112
B.	Conditions Governing Apprenticeship Training	113
C.	Requirements for Provincial Certification	120
D.	Roles and Responsibilities of Stakeholders in the Apprenticeship Process	121

A. Program Structure

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

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

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

Block I			
NL Course No.	Course Name	Hours	Pre-Requisite
TS1510	Occupational Health & Safety	6	None
TS1520	WHMIS	6	None
TS1530	Standard First Aid	14	None
OR1100	Safety	18	None
OR1110	Environmental Awareness	12	None
LA1110	Fall Protection Awareness	6	None
LA1100	Confined Space Awareness	6	None
OR1150	Hoisting, Lifting and Rigging	30	OR1100, TS1520, TS1530, LA1110
OR1160	Tools and Equipment	12	OR1100, TS1520, TS1530, LA1110, LA1100
OR1170	Piping and Instrumentation Drawings	24	OR1210
PH1020	Physics	72	AM1100, AM1280
OR1200	Electrical Fundamentals	30	OR1160
CH1020	Chemistry	72	AM1100, AM1280

Block I			
NL Course No.	Course Name	Hours	Pre-Requisite
OR1210	Process Measurement	90	OR1160, PH1020
OR1220	Process Analyzers	60	CH1020, OR1100, TS1520, TS1530
OR1230	Final Control Elements	60	None
OR1300	Basic Process Control	150	OR1230
OR1311	HMI and Process Control Systems	12	OR1300
OR1320	Pumps	18	PH1020
OR1330	Introduction to Process Operations	30	OR1100, OR1300, TS1520, TS1530
AP1101	Introduction to Apprenticeship	15	None
*AM1100	Math Essentials	30	None
AM1280	Process Math Fundamentals	30	AM1100
CM2160	Communication Essentials	45	None
SD1760	Workplace Essentials	45	None
MC1060	Computer Essentials	15	None
Total Hours		908	

Required Work Experience

***A student who can meet the mathematics requirement through an ACUPLACER® test may be exempted from AM1100 - Math Essentials. Please check with your training institution.**

**Hydrometallurgical Refining			
Block II			
NL Course No.	Course Name	Hours	Pre-Requisite
OR2100	Introduction to the Hydrometallurgical Process	30	Block I
OR2110	Feed Preparation and Handling	12	Block I
OR2120	Neutralization	30	Block I
OR2200	Pressure Oxidative Leaching	18	Block I
OR2210	Solvent Extraction and Cadmium Removal	30	Block I
OR2220	Electrowinning	18	Block I
OR2230	Water Effluent and Residue Treatment	12	Block I
Total Hours		150	

**Mineral Processing			
Block II			
NL Course No.	Course Name	Hours	Pre-Requisite
OR2300	Mineral Processing I	62	Block I
OR2310	Mineral Processing II	18	Block I
OR2320	Mineral Processing III	70	Block I
Total Hours		150	

Required Work Experience

****An apprentice is required to complete 1 of the block two's listed (Subject to the industry s/he is employed)**

Common Advanced Courses			
Block III			
NL Course No.	Course Name	Hours	Pre-Requisite
OR2400	Advanced Control Systems	90	Block II
OR2410	Advanced Process Control	66	Block II
OR2420	Troubleshooting Techniques	18	Block II
OR2440	Work Planning	6	Block II
Total Hours		180	
Total Course Credit Hours		1238	

BLOCK I

TS1510 Occupational Health and Safety

Learning Outcomes:

- Demonstrate knowledge of interpreting the Occupational Health and Safety Act, laws and regulations.
- Demonstrate knowledge of understanding the designated responsibilities within the laws and regulations such as the right to refuse dangerous work; and the importance of reporting accidents.
- Demonstrate knowledge of how to prevent accidents and illnesses.
- Demonstrate knowledge of how to improve health and safety conditions in the workplace.

Duration: 6 Hours

Pre-requisite(s): None

Objectives and Content:

1. Interpret the Occupational Health and Safety Act laws and regulations.
 - i. explain the scope of the act
 - application of the Act
 - Federal/Provincial jurisdictions
 - Canada Labour Code
 - rules and regulations
 - private home application
 - conformity of the Crown by the Act
2. Explain responsibilities under the Act and Regulations.
 - i. duties of employer, owner, contractors, sub-contractors, employees, and suppliers
3. Explain the purpose of joint health and safety committees.
 - i. formation of committee
 - ii. functions of committee

- iii. legislated rights
 - iv. health and safety representation
 - v. reporting endangerment to health
 - vi. appropriate remedial action
 - vii. investigation of endangerment
 - viii. committee recommendation
 - ix. employer's responsibility in taking remedial action
4. Examine right to refuse dangerous work.
- i. reasonable grounds for refusal
 - ii. reporting endangerment to health
 - iii. appropriate remedial action
 - iv. investigation of endangerment
 - v. committee recommendation
 - vi. employer's responsibility to take appropriate remedial action
 - vii. action taken when employee does not have reasonable grounds for refusing dangerous work
 - viii. employee's rights
 - ix. assigning another employee to perform duties
 - x. temporary reassignment of employee to perform other duties
 - xi. collective agreement influences
 - xii. wages and benefits
5. State examples of work situations where one might refuse work.
6. Describe discriminatory action.
- i. Definition
 - ii. filing a complaint procedure
 - iii. allocated period of time a complaint can be filed with the Commission
 - iv. duties of an arbitrator under the Labour Relations Act
 - v. order in writing inclusion
 - vi. report to commission allocated period of time to request arbitrator to deal with the matter of the request
 - vii. notice of application
 - viii. failure to comply with the terms of an order
 - ix. order filed in the court
7. Explain duties of commission officers.
- i. powers and duties of officers

- ii. procedure for examinations and inspections
 - iii. orders given by officers orally or in writing
 - iv. specifications of an order given by an officer to owner of the place of employment, employer, contractor, sub-contractor, employee, or supplier
 - v. service of an order
 - vi. prohibition of persons towards an officer in the exercise of his/her power or duties
 - vii. rescinding of an order
 - viii. posting a copy of the order
 - ix. illegal removal of an order
8. Interpret appeals of others.
- i. allocated period of time for appeal of an order
 - ii. person who may appeal order
 - iii. action taken by commission when person involved does not comply with the order
 - iv. enforcement of the order
 - v. notice of application
 - vi. rules of court
9. Explain the process for reporting of accidents.
- i. application of act
 - ii. report procedure
 - iii. reporting notification of injury
 - iv. reporting accidental explosion or exposure
 - v. posting of act and regulations

Practical Requirements:

- 1. Conduct an interview with someone in your occupation on two or more aspects of the act and report results.
- 2. Conduct a safety inspection of shop area.

TS1520 Workplace Hazardous Materials Information System (WHMIS)

Learning Outcomes:

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

Duration: 6 Hours

Pre-requisite(s): None

Objectives and Content:

1. Define WHMIS safety.
 - i. rational and key elements
 - ii. history and development of WHMIS
 - iii. WHMIS legislation
 - iv. WHMIS implementation program
 - v. definitions of legal and technical terms

2. Examine hazard identification and ingredient disclosure.
 - i. prohibited, restricted and controlled products
 - ii. classification and the application of WHMIS information requirements
 - iii. responsibilities for classification
 - the supplier
 - the employer
 - the worker - Classification: rules and criteria
 - information on classification
 - classes, divisions and subdivision in WHMIS
 - general rules for classification
 - class A - compressed gases
 - class B - flammable and combustible materials
 - class C - oxidizing material
 - class D - poisonous and infectious material
 - class E - corrosive material
 - class F - dangerously reactive material

- iv. products excluded from the application of WHMIS legislation
 - consumer products
 - explosives
 - cosmetics, drugs, foods and devices
 - pest control products
 - radioactive prescribed substances
 - wood or products made of wood
 - manufactured articles
 - tobacco or products of tobacco
 - hazardous wastes
 - products handled or transported pursuant to the Transportation of Dangerous Goods (TDG) Act
 - v. comparison of classification systems – WHMIS and TDG
 - vi. general comparison of classification categories
 - vii. detailed comparison of classified criteria
3. Explain labeling and other forms of warning.
- i. definition of a WHMIS label
 - supplier label
 - workplace label
 - other means of identification
 - ii. responsibility for labels
 - supplier responsibility
 - employer responsibility
 - worker responsibility
 - iii. introduce label content, design and location
 - supplier labels
 - workplace labels
 - other means of identification

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

Practical Requirements:

1. Locate WHMIS label and interpret the information displayed.
2. Locate a MSDS sheet for a product used in the workplace and determine what personal protective equipment and other precautions are required when handling this product.

TS1530 Standard First Aid

Learning Outcomes:

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

Duration: 14 Hours

Pre-requisite(s): None

Objectives and Content:

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

OR1100 Safety

Learning Outcomes:

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

Duration: 18 Hours

Pre-Requisites: None

Objectives and Content:

1. Identify types of personal protective equipment (PPE) and clothing and describe their applications, limitations and procedures for use.
2. Describe the procedures used to care for, maintain and store PPE.
3. Identify hazards and describe safe work practices.
 - i. personal
 - ii. workplace
 - electrical
 - fixed motorized equipment
 - isolation and de-energizing procedures
 - tag out/lockout
 - confined space
 - trenches
 - fire
 - heights
 - asbestos
 - iii. environment
 - iv. hotwork

4. Identify and describe workplace safety and health regulations and certification requirements.
 - i. provincial
 - ii. federal

5. Describe the safe use of motorized equipment such as:
 - i. overhead crane
 - ii. forklift
 - iii. skid steer loader
 - iv. aerial lifts

Practical Requirements:

None

OR1110 Environmental Protection Awareness

Learning Outcomes:

- Demonstrate knowledge of Federal and jurisdictional environmental protection regulations.
- Demonstrate knowledge of environmental contamination.
- Demonstrate knowledge of environmental practices.

Duration: 12 Hours

Pre-Requisites: None

Objectives and Content:

1. Describe Federal regulations to protect environment.
 - i. employer responsibilities
 - ii. employee responsibilities
2. Describe jurisdictional requirements and regulations.
 - i. employer responsibilities
 - ii. employee responsibilities
3. Describe environmental protection management.
 - i. implementation and operation
4. Explain preventative measures.
 - i. planning
 - ii. auditing
 - iii. sampling
5. Explain environmental contamination.
 - i. air
 - ii. water
 - iii. soil
 - iv. waste disposal

6. Explain environmental impact if there is an incident.
 - i. incident response
 - ii. reporting and investigation

Practical Requirements:

None

LA1110 Fall Protection Awareness

Learning Outcomes:

- Demonstrate knowledge of various types of fall protection and their components.
- Demonstrate knowledge of the proper use of fall protection equipment and personal fall arrest systems.
- Demonstrate knowledge of fall hazards in the workplace and take corrective measures to eliminate them through the selection of appropriate fall protection systems.

Duration: 6 Hours

Pre-Requisites: None

Objectives and Content:

1. Define the term fall protection.
2. Explain why fall protection is important in the workplace.
3. Determine when to use fall protection.
4. List the A, B, C, D's of a complete fall protection system.
5. Describe the basic function of a travel restrict system.
 - i. permanent and temporary guard rails
 - ii. personal travel restrict systems
6. Describe the basic function of a fall arrest system.
 - i. identify the components of a personal fall arrest system
 - full body harness
 - shock absorbers
 - lanyards

- lifelines
 - vertical
 - horizontal
 - rope grabs
 - anchors
- ii. explain how to put on a full body harness
7. Describe the basic function of a work positioning system.
- i. list the components of a personal work positioning system
8. Explain when inspections on equipment must be conducted and what action must be taken if defects or damage is discovered.
- i. list components of equipment that require inspection

Practical Requirements:

1. To be determined by instructor.

LA1100 Confined Space Awareness

Learning Outcomes:

- Demonstrate knowledge of properly preparing a confined space for entry.
- Demonstrate knowledge of entering a confined space safely.
- Demonstrate knowledge of performing their duties as an attendant.
- Demonstrate knowledge of dealing with an emergency.

Duration: 6 Hours

Pre requisites: None

Objectives and Content:

1. Recognize confined space hazards.
 - i. define a confined space
 - ii. identify types of hazards in confined spaces
2. Identify proper controls for confined space entries.
 - i. list steps to protect yourself from confined space hazards
 - ii. define an entry permit
 - iii. list information included on a confined space entry permit
 - iv. explain what action must be taken if a permit expires before work is completed
3. Preparing for confined space entry.
 - i. state the first step in entry preparation
 - ii. list examples of proper entry preparation
 - iii. list types of personal protective equipment used in confined spaces
4. Determine testing techniques for confined spaces.
 - i. list the necessary steps of air testing
 - ii. state the correct order for testing gases

5. Identify confined space entry procedures.
 - i. identify the attendants responsibilities
 - ii. identify the area where the attendant should be stationed
 - iii. identify the entrants responsibilities

6. Explain confined space rescue techniques.
 - i. list three types of confined space rescues
 - ii. explain non-entry rescue
 - iii. list the requirements of an on-site rescue team

Practical Requirements:

1. To be determined by instructor.

OR1150 Hoisting, Lifting and Rigging

Learning Outcomes:

- Demonstrate knowledge of hoisting, lifting and rigging equipment, their applications, limitations and procedures for use.
- Demonstrate knowledge of the procedures used to perform hoisting and lifting operations.
- Demonstrate knowledge of calculations required when performing hoisting and lifting operations.

Duration: 30 Hours

Pre-Requisites: OR1100, TS1520, TS1530, LA1110

Objectives and Content:

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

8. Identify types of knots, hitches and bends and describe their applications and the procedures used to tie them.
9. Describe the procedures used to rig material/equipment for lifting.
10. Describe the procedures used to ensure the work area is safe for lifting.
 - i. supervision of lift
 - ii. securing work area
 - iii. communication
11. Identify and describe procedures used to communicate during hoisting, lifting and rigging operations.
 - i. hand signals
 - ii. electronic communications
 - iii. audible/visual
12. Explain sling angle when preparing for hoisting and lifting operations.
13. Describe the procedures used to determine the weight and weight distribution of loads.
 - i. reference load charts
 - ii. determine types of loads
 - iii. engineered lifts
14. Identify the factors to consider when selecting rigging equipment.
 - i. load characteristics
 - ii. environment
15. Describe the procedures used to perform a lift.
 - i. load determination
 - ii. communication methods
 - iii. pre-lift checks
 - iv. placement of load
 - v. post-lift inspection

Practical Requirements:

1. Conduct pre-inspection of an overhead crane and rigging material.
2. Calculate a load for an overhead crane.
3. Select rigging material for an overhead crane.
4. Perform rigging and hoisting techniques with an overhead crane.

OR1160 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.

Duration: 12 Hours

Pre-Requisites: OR1100, TS1520, TS1530, LA1110, LA1100

Objectives and Content:

1. Identify types of hand tools and describe their applications and procedures for use.
2. Describe the procedures used to inspect and maintain hand tools.
3. Identify types of portable power tools and describe their applications and procedures for use.
 - i. electric
 - ii. hydraulic
 - iii. pneumatic
4. Describe the procedures used to inspect and maintain 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 powder actuated tools and describe their applications.

8. Identify types of shop equipment
 - i. overhead crane
 - ii. forklifts
 - iii. skid steer loader
 - iv. aerial lifts

Practical Requirements:

1. Demonstrate safe use and application of various hand and power tools
2. Demonstrate safe use and application of various pieces of motorized equipment.

OR1170 Piping and Instrumentation Drawings

Learning Outcomes:

- Demonstrate knowledge of Piping and Instrumentation Drawings
- Demonstrate knowledge of interpreting and extracting information from drawings.

Duration: 24 Hours

Pre-Requisites: OR1210

Objectives and Content:

1. Define terminology associated with drawings and specifications.
2. Identify types of drawings and describe their applications.
 - i. mechanical
 - plant layout
 - process equipment details
 - ii. process
 - Process and Instrument Drawings/Process and Control (P&ID/P&C)
 - iii. as-builts
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 Piping and Instrumentation diagrams.

Practical Requirements:

1. Using a P & ID identify each piece of equipment in a process.

PH1020 Physics

Learning Outcomes:

- Demonstrate knowledge of the nature of physics.
- Demonstrate knowledge of motion; kinematics in one dimension.
- Demonstrate knowledge of kinematics in two dimension: vectors.
- Demonstrate knowledge of motion and force: dynamics.
- Demonstrate knowledge of circular motion: gravitation.
- Demonstrate knowledge of bodies in equilibrium.
- Demonstrate knowledge of work and energy.
- Demonstrate knowledge of linear momentum.
- Demonstrate knowledge of fluid mechanics.

Duration: 72 Hours

Pre-Requisites: AM1100, AM1280

Objectives and Content:

1. The nature of physics.
 - i. the practice of science
 - distinguish between scientific facts and theories
 - explain the use of the scientific method in the study of physics
 - ii. physics and its relation to other fields
 - explain the relationship of physics to the other basic sciences
 - iii. models, theories and laws
 - iv. measurement and uncertainty
 - v. standards and units: the S.I.
 - list the fundamental units of length, mass and time in the S.I.
 - five examples of derived units in the S.I.

2. Describing motion: kinematics in one dimension.
 - i. speed
 - define speed
 - calculate the average speed of an object
 - ii. reference frames and co-ordinate systems
 - locate a point by using a rectangular co-ordinate system
 - give examples of different reference frames
 - iii. conversion of units
 - convert the values of physical quantities within the S.I. (eg. km/h to m/s)
 - solve problems involving dimensional analysis
 - iv. linear velocity: displacement
 - define displacement and linear velocity
 - distinguish between displacement and distance
 - distinguish between velocity and speed
 - calculate the average velocity of an object
 - v. instantaneous velocity
 - define instantaneous velocity
 - distinguish between instantaneous velocity and average velocity
 - vi. vector and scalar quantities
 - define vector quantities
 - define scalar quantities
 - give examples of vector quantities and scalar quantities
 - vii. acceleration
 - define acceleration
 - calculate the average acceleration of an object
 - viii. uniformly accelerated motion
 - write the equations of motion for an object undergoing uniformly accelerated motion
 - calculate the displacement, acceleration, initial and final velocities of an object undergoing uniformly accelerated motion
 - ix. problem solving
 - examine techniques and hints for problem solving
 - x. acceleration under the action of gravity
 - explain Galileo's postulate
 - calculate the position and velocity of an object moving freely in a vertical path, given initial conditions of position, velocity and
 - explain the terms "air friction" and "terminal velocity"
 - xi. graphical analysis of linear motion

- describe linear motion by graphical analysis
3. Kinematics in two dimensions: vectors.
- i. addition and subtraction of vector quantities
 - add or subtract two vector quantities whose directions are at 0, 180, 90, with respect to each other
 - add two vector quantities using the parallelogram method
 - add two or more vectors by the polygon method
 - add or subtract two or more vectors using the law of cosines and the law of sines
 - add or subtract two or more vectors using the component method.
 - ii. relative velocity
 - add or subtract the velocities of several moving objects within a fixed reference frame
 - iii. projectile motion
 - determine the horizontal and vertical position of a projectile given its initial velocity
 - determine the time after its release it will attain any horizontal or vertical distance given
 - determine the distance and time it will intersect a given horizontal surface
4. Motion and force: dynamics.
- i. force
 - define force and give examples of forces
 - ii. Newton's first law of motion
 - state in words and by practical example the principle of inertia
 - iii. mass
 - explain the concept of mass in terms of Newton's first law
 - Newton's second law of motion
 - state in words and by practical example, Newton's second law of motion
 - calculate the force required to produce an observed acceleration of an object of given mass

- iv. Newton's third law of motion
 - state in words and by practical example the meaning of an action-reaction pair of forces
 - given a force, determine its appropriate reaction force
 - v. Weight: The force of gravity
 - explain the difference between the mass of an object and its weight
 - determine the weight of a given mass at the earth's surface
 - determine the mass of a given weight at the earth's surface
 - vi. applications of Newton's Laws: vector forces
 - apply Newton's Laws to problems involving the motion of an object or system of objects when a number of vector forces are acting
 - analyze the forces acting on an object resting or moving on an inclined plane
 - vii. friction
 - distinguish between static friction and kinetic friction
 - determine the coefficient of friction between two surface from given forces and masses
 - apply the appropriate value of the coefficient of friction to determine the magnitude of the frictional force
5. Circular Motion: Gravitation.
- i. uniform circulation motion
 - define centripetal acceleration and centripetal force
 - determine the speed and/or acceleration of an object moving in uniform circular motion from its period of motion and the radius of its motion
 - ii. Newton's Law of Universal Gravitation
 - state the Law of Universal
 - solve simple two body problems involving the law
 - iii. gravity near the earth's surface
 - calculate the acceleration caused by the earth at a given point in space above the earth's surface
 - iv. satellites and "weightlessness"
 - explain why a satellite is capable of staying in orbit
 - calculate the velocity and orbital radius for an object moving in a circular orbit

6. Bodies of equilibrium.
 - i. statics: the conditions for equilibrium
 - state the first condition for equilibrium and the second condition for equilibrium in words and mathematically
 - apply the conditions of equilibrium to problems involving firstly, a particle and secondly, a rigid body
 - ii. simple machine: levers and pulleys
 - explain the operation of the lever and pulley
 - solve simple problems involving levers and pulley systems
 - iii. stability and balance
 - use examples to explain objects in stable, unstable and neutral equilibrium

7. Work and energy.
 - i. work done by a constant force
 - define work
 - calculate the work done by a given force acting on a body through a specified displacement
 - ii. kinetic energy and the work energy theorem
 - define kinetic energy
 - state the work energy theorem
 - calculate the kinetic energy of specified objects moving at a given speed
 - apply the work-energy theorem to problems with and without non-conservative forces acting
 - iii. potential energy
 - define potential energy
 - calculate gravitational potential energy of objects
 - calculate the elastic potential energy of spring like systems from the spring constant and displacement
 - iv. the law of conservation of energy
 - state the law of conservation of energy
 - solve simple problems involving potential - kinetic energy transformations
 - v. power
 - define power
 - solve simple problems involving the expending of energy over a time interval

8. Linear momentum.
 - i. momentum and force
 - define linear momentum
 - ii. conservation of momentum
 - state the law of conservation of momentum
 - iii. impulse: collisions
 - define impulse
 - determine the change in momentum from the impulses
 - solve simple problems involving the momentum of a two body system during collision
 - iv. conservation of energy and momentum in collisions
 - distinguish between elastic and inelastic collisions
 - solve simple problems involving the conservation of energy and momentum during collisions
 - solve problems involving collisions in two dimensions
 - center of mass
 - explain the concepts "centre of mass" and "centre of gravity"
 - calculate the position of the centre of mass of a system of bodies

9. Fluid mechanics.
 - i. density and specific gravity
 - distinguish between density and specific gravity
 - calculate the density of a substance in kg/m^3 .
 - given the density or specific gravity of a substance, calculate the other quantity
 - ii. pressure in fluids
 - calculate pressure as a function of depth in a fluid of known density
 - atmospheric pressure and gauge pressure
 - distinguish between gauge pressure and absolute pressure
 - calculate the absolute pressure, given a gauge pressure
 - iii. Pascal's principle
 - state Pascal's principle
 - solve simple problems involving Pascal's principle
 - iv. measurement of pressure: gauges and the barometer
 - describe the use of the open manometer and mercury barometer
 - v. buoyancy and Archimedes' principle
 - define buoyancy
 - state Archimedes' principle

- calculate the buoyant force on an object immersed in a fluid
- vi. fluid dynamics
 - state Bernoulli's principle
 - apply the work-energy equation to a fluid system to yield the Bernoulli equation
 - examine some applications of Bernoulli's principle in everyday life
 - discuss Torricelli's theorem

Practical Requirements:

1. Labs to be determined by instructor.

OR1200 Electrical Fundamentals

Learning Outcomes:

- Demonstrate knowledge of direct current (DC) electricity, its characteristics and associated principles.
- Demonstrate knowledge of Ohm's law.
- Demonstrate knowledge of units of measure and symbols relating to DC electricity.
- Demonstrate knowledge of the instruments and procedures used to measure electricity.

Duration: 30 Hours

Pre-Requisites: OR1160

Objectives and Content:

1. Define terminology associated with DC electricity.
2. Define alternating current.
3. Define direct current.
4. Identify hazards and describe safe work practices pertaining to DC electricity.
5. Explain atomic structure of matter and electron theory.
 - i. conductors
 - ii. semi-conductors
 - iii. insulators
6. Identify the forms of energy that produce electricity and describe their associated principles.
 - i. chemical action
 - ii. piezoelectric effect
 - iii. mechanical/magnetism
 - iv. heat

- v. light and solar
 - vi. friction
7. Describe basic electric circuits.
 - i. electron path (conductors)
 - ii. load
 - iii. source
 - iv. control
 8. Identify basic components found in DC electric circuits and describe their characteristics and purpose.
 9. Identify units of measure and symbols pertaining to DC electricity.
 10. Explain Ohm's Law.
 11. Identify the basic electrical properties and describe their relationship.
 - i. voltage
 - ii. current
 - iii. resistance
 - iv. power
 12. Identify instruments used for measuring electricity and describe their applications and procedures for use.
 13. Perform calculations to determine electricity related values.
 14. Use instruments to troubleshoot DC components.
 - i. closed circuit
 - ii. open circuit
 - iii. short circuit
 15. Demonstrate knowledge of solid state DC and variable frequency drives (VFDs), their applications and operation.

SINGLE PHASE

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

17. Define different values and terms of alternating current.
 - i. alternating current values
 - ii. instantaneous values
 - iii. maximum (peak) values
 - iv. peak to peak values
 - v. effective (RMS) values
 - vi. average values
 - vii. Terminology of alternating current circuits
 - viii. frequency / hertz
 - ix. period
 - x. phase (in phase, lagging, leading)

THREE-PHASE THEORY

18. Describe the generation of three-phase voltages.
 - i. characteristics of three-phase
 - ii. voltage generation of three-phase voltages
 - iii. phase sequence

Practical Requirements:

1. Compute values of electrical energy and power.
2. Use electrical measuring instruments.
3. Determine the properties of an AC circuit.

CH1020 Chemistry

Learning Outcomes

- Demonstrate knowledge of Atomic Structure.
- Demonstrate knowledge of the Periodic Table.
- Demonstrate knowledge of Chemical Bonding and Nomenclature.
- Demonstrate knowledge of Mole Calculations.
- Demonstrate knowledge of Chemical Reactions.
- Demonstrate knowledge of Kinetic Molecular Theory and Gas Laws.

Duration: 72 Hours

Pre-Requisites: AM1100, AM1280

Objectives and Content:

1. Atomic structure.
 - i. fundamentals of measurement
 - define the Canadian System of Measurements (SI)
 - define accuracy, precision and significant figures
 - perform calculations involving significant figures
 - ii. composition of matter
 - elements and compounds
 - distinguish between elements and compounds
 - describe how a chemical symbol is written
 - state the chemical symbol given the name and name given the symbol for the following elements of the Period Table: H, He, Li, Be, B, C, N, O, F, NE, Na, Mg, Al, Si, P, S, Cl, Ar, K, Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ge, Ag, Br, Pd, Cd, I, Cs, Ba, W, Pt, Hg, Pb, Rn, Sn, Au, U
 - Law of Constant Composition
 - state the Law of Constant Composition
 - Law of Multiple Proportion
 - state the Law of Multiple Proportion
 - define atom
 - iii. subatomic particles
 - state that an atom is composed of protons, electrons and neutrons

- state that the protons are positively charged with a relative mass = 1
 - state that the neutrons are neutral, with a relative mass = 1
 - state that the electrons are negatively charged with negligible mass
 - state that an atom is composed of an extremely small central nucleus containing protons and neutrons by electrons
 - state that an atom has an equal number of protons and electrons and is therefore electrically neutral
- iv. atomic number and mass
- define atomic number as the number of protons in the nucleus
 - define mass number as the total number of protons and neutrons in the nucleus
 - use the periodic table to determine the atomic number of an element
 - use any suitable combination of atomic number, mass number, number of protons, electrons and neutrons to deduce the others
 - define average atomic mass
 - calculate average atomic mass from given values of percent abundance
- v. isotopes
- illustrate the occurrence of isotopes
 - explain what makes a nucleus stable
 - give examples of uses of isotopes
- vi. quantum mechanical model of the atom
- state that electrons can be found in energy levels and sub-levels
 - define s, p, d and f suborbitals
 - apply Aufbau principle to the concept of orbitals
 - state that in the quantum mechanical model of the atom, electrons can be grouped according to their ease of removal from the atom, which depends on their distance from the nucleus
 - write the simple electronic configuration of an atom in terms of electrons based in sub-levels, given the atomic number concerned
 - define valence electrons
 - predict the number of valence electrons in an atom
 - define ion
 - list two types of ions
 - name positive ions as cations
 - name negative ions as anions

2. Periodic Table.

- i. structure of the Periodic Table
 - state that elements are arranged in the Periodic Table in order of increasing atomic number
 - state that horizontal rows of elements are called periods and vertical columns are called groups or families, and that elements in the same group have similar properties
 - state that Groups IA through VIIIA are called main groups; that elements in Groups IB through VIIIB are called transition metals; and that the two rows of elements placed below the main part of the table are called lanthanons and actinons
 - state that Groups IA are known as the alkali metals, Group IIA are known as the alkaline earth metals, Groups VIIA are known as the halogens, and that Group VIIIA are known as the noble gases
 - classify elements as main group or transition elements
 - classify main group elements to a particular group or family
- ii. metals and nonmetals
 - state that all elements can be classified as either metals, non-metals, or semimetals (metalloids)
 - state the properties of metals, non-metals and semimetals
 - classify elements as metals, nonmetals or semimetals based on their position in the Periodic Table, or on given properties
 - relate the state of the elements to the degree of metallic character
 - define semiconductor
 - state which semimetals are semiconductors
- iii. families of elements
 - state basic physical and chemical properties of the alkali metals, alkaline earth metals, halogens and noble gases
 - periodic variation
 - define density
 - describe periodic trends in density
 - relate simple electronic configuration to position in the Periodic Table.
 - realize that an electronic configuration ending in s^2p^6 portrays a stable noble gas configuration
 - describe how metals lose valence electrons and nonmetals gain valence electrons to obtain ions with a stable electron configuration
 - define atomic radius

- define ionic radius
 - define ionization energy
 - define electron affinity
 - describe and explain the trends in valence electrons, metallic/nonmetallic character, ionic radius, atomic radius, ionization energy and electron affinity across a period and within a group of the Periodic Table
 - predict physical properties of elements based on trends within a group
3. Chemical bonding and nomenclature.
- i. states of matter
 - define solids, liquids, and gases
 - define phase change
 - define melting, freezing, and melting and freezing points
 - define vapour and vapour pressure
 - define boiling and boiling point
 - explain evaporation, condensation, sublimation, deposition, melting, freezing, and boiling in terms of kinetic molecular theory
 - ii. Octet rule
 - state that atoms bond in such a way as to obtain a stable electron configuration
 - define the Octet rule
 - iii. ionic bonding
 - ions - charge on main group elements and common transition elements
 - describe how atoms form ions through electron transfer and how ions are held together in the crystal lattice
 - definition of the ionic bond
 - state that ionic bonds are formed by the transfer of electrons from a metallic element to a non-metallic element
 - state that compounds formed between metals and nonmetals are generally ionic compounds
 - state that the smallest unit of an ionic compound is the formula unit
 - ionic trends
 - describe and explain the trends in melting point, boiling point and conductivity of ionic compounds
 - electron-dot formula of ionic compounds

- draw electron-dot formulae for atoms
- draw electron-dot formulae for binary ionic compounds
- chemical formulae and nomenclature of ionic compounds
 - write formulae for binary ionic compounds given the systematic name and give the names knowing the formulae
 - name common polyatomic ions
 - write formulae for compounds containing polyatomic ions, using appropriate prefixes and suffixes
 - define hydrate
 - write formulae and names for hydrates
- iv. covalent bonding
 - definition of the covalent bond
 - describe the covalent bond in terms of mutual attraction of nuclei for shared electrons
 - state that covalent bonds form between nonmetallic elements, and that compounds formed between non-metallic elements are known as covalent compounds
- v. state that the smallest unit of a covalent compound is a molecule
 - electron-dot formulae of covalent compounds
 - draw electron-dot formulae for covalent compounds
 - chemical formulae and nomenclature of covalent compounds
 - write formulae for binary covalent compounds given the systematic name and give names knowing formulae
 - multiple bonds
 - identify covalent bonds as single (one shared pair of electrons), double (two shared pairs of electrons), or triple (three shared pairs of electrons)
 - write electron-dot structures for covalent compounds with multiple bonds
 - covalent trends
 - describe and explain trends in melting points, boiling points and conductivity of covalent compounds
 - polar covalent bonding
 - define electronegativity and describe the trends in electronegativity within the Periodic Table
 - depending on the electronegativity, explain why a bond is purely ionic, purely covalent or polar covalent
 - identify the atoms which are partially negative and which are partially positive in a binary covalent bond

- vi. polarity of molecules
 - state molecular polarity may be determined by
 - the presence of lone pairs of electrons on the central atom in a molecule, or
 - the presence of different elements surrounding the central atom, or
 - binary molecules involving two different elements
 - sketch molecular shapes for binary covalent compounds using VSEPR theory
 - vii. intermolecular forces
 - distinguish between intermolecular and intramolecular forces
 - describe:
 - dispersion forces
 - dipole-dipole forces
 - hydrogen bonding forces
 - determine the type of intermolecular forces that exist between molecules
 - explain trends in physical properties, such as melting and boiling points, by considering the type of intermolecular forces between molecules
 - explain, using hydrogen bonding, why water has unique properties such as its density as a solid, high melting and boiling points and thermal properties
 - viii. acids and bases
 - properties of acids and bases
 - list properties of acids and bases
 - explain the properties of acids in terms of hydrogen ions
 - explain the properties of bases in terms of hydroxide ions
 - nomenclature of acids and bases
 - write formulas and names of common acids and bases
4. Mole calculations.
- i. Avogadro's number - the mole
 - define atomic mass relative to 12 C
 - define the Avogadro constant as the number of atoms in 12g of 12 C
 - define the mole as the amount of substance containing the number of particles equal to Avogadro constant
 - molecular and Formula Mass, Molar Mass
 - calculate the masses of moles of elements and compounds.

- calculate the number of moles in a given mass of pure compound.
- calculate the number of particles (atoms, molecules or formula units) in a given mass of a pure substance.
- ii. types of solutions
 - explain the nature of unsaturated, saturated and supersaturated solutions
 - describe how to distinguish one from the other by addition of a seed crystal
 - state that solutions may be in one of three phases: gases, liquids or solids
 - state that the most common type of solid-in-solid solutions are called alloys, and that the most common type of liquid-in-solid solutions are called amalgams
 - use the terms miscible and immiscible to describe the solubility of a liquid in a liquid
 - explain that the miscibility of liquids, and solubility of solids and gases in liquids, depends on intermolecular attractive forces
- iii. factors affecting solubility
 - define solubility in terms of mass of solute and mass of solvent
 - state that the solubility of solids in liquids depends on the temperature
 - state that the solubility of a gas in a liquid depends on the pressure of the gas above the liquid and temperature
 - predict whether an ionic compound will dissolve or mix in water using a solubility table
- iv. concentration of solutions
 - concentration
 - define concentration
 - define, solute, solvent, solution
 - standard solutions
 - define a standard solution as containing a precise mass of solute in a precise volume of solution
 - calculate molarity, given the mass of solute and volume of solvent
 - calculate mass, volume or molarity, given any two of these
 - percent by mass and PPM
 - express the concentration of a solution in terms of percent by mass (mass/mass, mass/volume and volume/volume) and parts per million (mass/mass and mass/volume)

- ion concentrations
 - v. state that ionic substances dissociate into ions when dissolved in water and that some molecular substances ionize when dissolved in water
 - calculate the concentration of each ion in salt or acid solutions knowing the concentration of the salt
5. Chemical reactions.
- i. Law of Conservation of Mass
 - state the Law of Conservation of Mass
 - ii. Chemical Reactions
 - writing and balancing chemical equations
 - define chemical reaction
 - iii. list the changes that indicate a chemical reaction has taken place
 - define chemical equation
 - define reactants and products
 - write chemical equations for simple reactions, given names of reactants and products
 - use appropriate subscripts to indicate physical states of reactants and products
 - balance simple reactions, given the name of formulae of the reactants and products
 - reaction types
 - identify a chemical reaction as combination, decomposition, single or double replacement, neutralization, precipitate formation and combustion
 - iv. write the products for the complete combustion of hydrocarbons
 - write the product for combination reactions involving:
 - two elements
 - formation of hydrates
 - nonmetal and metal oxide with water
 - write the products for decomposition reactions of:
 - a compound into its elements
 - a hydrate
 - carbonates
 - use the activity series to determine whether or not single replacement reactions will occur, and write the products of the reaction
 - write the products for neutralization reactions

- predict the formation of a precipitate in a double replacement reaction given solubility rules
 - predict the products for the addition of acids to carbonates and bicarbonates
 - net ionic reactions
 - write total ionic equations from molecular equations
 - identify spectator ions
 - write net ionic equations from molecular equations
 - v. oxidation and reduction reactions
 - recognize examples of redox reactions that affect materials
 - define oxidation and reduction in terms of electron transfer
 - define oxidation number
 - state the range for oxidation numbers is from -4 to +7
 - state that the oxidation number of atoms in a polar covalently bonded molecule depends on the electronegativity values of each atom
 - deduce the oxidation number of an element in a given compound or ion using the rules for assigning oxidation numbers
 - define a redox reaction in terms of both change in oxidation number and electron transfer
 - vi. select examples of redox reactions from a given set of equations
 - define an oxidizing agent as an element that undergoes reduction
 - define a reducing agent as an element that undergoes oxidation
 - identify, in given redox reactions, which reactants are oxidizing agents and which are reducing agents
 - vii. stoichiometry
 - perform mole-mole and mass-mass calculations using a balanced equation.
 - perform calculations involving limiting reagents using a balanced equation.
 - calculate percent yield given experimental yield.
 - explain why experimental yield is different from theoretical yield.
6. Kinetic molecular theory and gas laws.
- i. characteristics and properties of gases
 - list and describe general characteristics of gases.
 - describe the kinetic theory of gases.
 - define pressure and list the most common units of pressure
 - define Boyle's Law

- use Boyle's Law in calculations
- Define and calculate Kelvin temperatures
- define Charles's Law
- use Charles's Law in calculations
- explain the relationship between Boyle's and Charles's Laws
- use the combined gas law in calculations
- ii. gas mixtures and partial pressure
 - explain Dalton's Law of Partial Pressure
 - calculate partial pressure of gases
 - explain Avogadro's Hypothesis
 - define standard temperature and pressure
 - define and calculate the molar volume of a gas
- iii. ideal gas law
 - define and derive the ideal gas law
 - define the universal gas constant
 - perform calculations based on gas laws and stoichiometry

Practical Requirements:

1. Labs to be determined by instructor.

OR1210 Process Measurement

Learning Outcomes:

- Demonstrate knowledge of process measurement and its associated principles.
- Demonstrate knowledge of process measuring and indicating devices, their components and operation.

Duration: 90 Hours

Pre-Requisites: OR1160, PH1020

Objectives and Content:

1. Define terminology associated with process measurement.
2. Identify hazards and describe safe work practices pertaining to process measurement.
3. Identify tools and equipment relating to process measuring and indicating devices and describe their applications and procedures for use.
4. Interpret information pertaining to process measuring and indicating devices found on drawings, specifications and nameplates.
5. Identify units of measure used to express process measurement values.
6. Identify forms of process measurement and explain their associated principles.
 - i. pressure
 - ii. temperature
 - iii. level
 - iv. flow

7. Identify types of process measuring and indicating devices and describe their characteristics and applications.
 - i. process switches
 - ii. indicators
 - iii. conventional transmitters
 - pneumatic
 - electronic
 - iv. smart transmitters
 - v. recorders and data loggers

Practical Requirements:

1. Application of process measurement.

OR1220 Process Analyzers

Learning Outcomes:

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

Duration: 60 Hours

Pre-Requisites: CH1020, OR1100, TS1520, TS1530

Objectives and Content:

1. Define terminology associated with process analyzers.
2. Identify hazards and describe safe work practices pertaining to process analyzers.
3. Identify tools and equipment relating to process analyzers and describe their applications and procedures for use.
4. Interpret information pertaining to process analyzers found on drawings and specifications.
5. Explain the principles of operation for process analyzers.

6. Identify types of process analyzers and describe their characteristics and applications:

SOLIDS AND LIQUIDS

- i. pH
- ii. oxidation reduction potential (ORP)
- iii. conductivity
- iv. dissolved oxygen (D.O.)
- v. mass and density
- vi. viscosity
- vii. consistency
- viii. turbidity
- ix. chromatography
- x. environmental
 - waste water
- xi. nuclear
 - solids composition
 - liquids composition

GASES

- xii. chromatography
 - xiii. spectrographic
 - xiv. lue gas analyzers
 - xv. environmental
 - gas
 - noise
7. Identify process analyzer components and describe their purpose and operation.
8. Describe the procedures used to maintain and troubleshoot process analyzers and their components.
9. Describe process sample conditioning and its importance to process analysis.
10. Describe the procedures and equipment used to obtain and condition samples for process analysis.

Practical Requirements:

1. Measure the PH of a liquid.
2. Measure the ORP of a liquid
3. Measure the conductivity of a liquid.

OR1230 Final Control Elements

Learning Outcomes:

- Demonstrate knowledge of final control elements, their accessories, components and operation.
- Demonstrate knowledge of basic troubleshooting final control elements, their accessories and components.

Duration: 60 Hours

Pre-Requisites: None

Objectives and Content:

1. Define terminology associated with final control elements.
2. Identify hazards and describe safe work practices pertaining to final control elements.
3. Identify tools and equipment relating to final control elements and describe their applications and procedures for use.
4. Interpret information pertaining to final control elements found on drawings, specifications and nameplates.
5. Identify types of final control elements and describe their components applications and operation.
 - i. valves
 - ii. dampers
 - iii. louvres
 - iv. positive displacement metering pumps
 - v. motors
 - vi. process regulators

6. 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
 - v. failsafe operation

7. 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

8. Describe the procedures used to basic, troubleshoot final control

Practical Requirements:

1. Demonstrate various final control element operations.
2. Perform troubleshooting techniques.

OR1300 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 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.

Duration: 150 Hours

Pre-Requisites: OR1230

Objectives and Content:

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

7. Identify methods of basic process control and describe their applications.
 - i. on-off
 - ii. feedback
 - iii. cascade
 - iv. auto selection (override)

8. Identify modes of process control and describe their characteristics, operation and combinations.
 - i. on-off
 - ii. proportional (P)
 - iii. integral (I)
 - iv. derivative (D)
 - v. P, I, PI, PD, PID

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 Requirements:

1. Interpret P&ID blueprints.

OR1311 HMI and Process Control Systems

Learning Outcomes:

- Demonstrate knowledge of process control systems.
- Demonstrate knowledge of Human Machine Interfaces.

Duration: 12 Hours

Pre-Requisites: OR1300

Content and Objectives:

1. Define process control systems
 - i. Distributed Control Systems (DCS)
 - define a DCS
 - describe the basic DCS functions
 - describe the overall structure
 - identify applications of DCS
 - ii. Programmable Logic Controllers (PLC)
 - define a PLC
 - describe the basic PLC functions
 - describe the overall structure
 - identify applications of PLC
 - iii. Supervisory Control and Data Acquisition (SCADA)
 - define SCADA
 - describe the basic SCADA functions
 - describe the overall structure
 - identify applications of SCADA
 - iv. Human Machine Interface (HMI)
 - define HMI
 - describe the basic HMI functions
 - describe the overall structure
 - identify applications of HMI

Practical Requirements:

1. Perform Process Control Operations using HMI software.

OR1320 Pumps

Learning Outcomes:

- Demonstrate knowledge of centrifugal and positive displacement pumps their components and operation.
- Demonstrate knowledge of the procedures used to troubleshoot, centrifugal and positive displacement pumps.

Duration: 18 Hours

Pre-Requisites: PH1020

Objectives and Content:

1. Define terminology associated with centrifugal and positive displacement pumps.
2. Identify hazards and describe safe work practices associated with centrifugal and positive displacement pumps.
 - i. achieve zero energy state
3. Identify types of centrifugal and positive displacement pumps and their components and describe their applications and operation.
4. Identify the types of seals and packing and describe their applications.
5. Identify tools and equipment used to troubleshoot centrifugal and positive displacement pumps and describe their applications and procedures for use.
6. Describe the procedures used to inspect centrifugal and positive displacement pumps.
7. Describe the procedures used to troubleshoot centrifugal and positive displacement pumps.

8. Identify considerations for determining if centrifugal and positive displacement pump maintenance is required.

Practical Requirements:

1. Adjust gland seal packing in a pump.
2. Perform pre-start and running checks on various pumps.

OR1330 Introduction to Process Operations

Learning Outcomes:

- Demonstrate knowledge of process operations and troubleshooting procedures in accordance with various plants.

Duration: 30 Hours

Pre-Requisites: OR1100, OR1300, TS1520, TS1530

Objectives and Content:

1. Explain start up and shut down process operations within various processing plants.
2. Describe troubleshooting procedures on process operations.
3. Define monitor process equipment.
4. Identify poor equipment performance.
 - i. corrective maintenance
 - ii. equipment instrument anomalies
5. Describe processes for unloading raw materials.
 - i. starting and stopping pumps
 - ii. opening and closing valves
6. Describe control transfer of component materials.
 - i. from locations within the manufacturing operation to processing
 - ii. from manufacturing lines
 - iii. from one line to another
7. Explain loading finished products.

8. Describe maintenance of processing equipment and components such as:
 - i. distillation units
 - ii. filters
 - iii. valves
 - iv. pumps and controls
 - v. heat exchangers
 - vi. piping systems
 - vii. electrical systems
 - viii. vacuum systems
 - ix. related field instrumentation

9. Describe vessel maintenance.
 - i. storage
 - ii. mixing
 - iii. blending
 - iv. decanting
 - v. oxidation
 - vi. hydrogenation
 - vii. pressure
 - viii. vacuum

10. Define chemical composition control.
 - i. chemical properties
 - ii. chemical analyses
 - iii. handling
 - iv. storing
 - v. transferring chemicals
 - vi. preparing chemicals
 - vii. monitoring yields and balances

11. Carry out product quality and statistical process control.
 - i. sampling products
 - ii. performing tests
 - iii. recording data
 - iv. completing required documentation

Practical Requirements:

1. Tour and observe an operating processing plant.
2. Write a detailed report.

AP1101 Introduction to Apprenticeship

Learning Outcomes:

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

Duration: 15 Hours

Pre-Requisite(s): None

Objectives and Content:

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

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

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

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

Practical Requirements:

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

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

AM1100 Math Essentials

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

Learning Outcomes:

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

Duration: 30 Hours

Pre-Requisite(s): None

Objectives and Content:

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

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

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

Practical Requirements:

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

AM1280 Process Math Fundamentals

Learning Outcomes:

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

Duration: 30 Hours

Pre-Requisite(s): AM1100

Objectives and Content:

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

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

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

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

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

Practical Requirements:

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

Note:

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

CM2160 Communication Essentials

Learning Outcomes:

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

Duration: 45 Hours

Pre-Requisite(s): None

Objectives and Content:

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

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

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

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

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

Practical Requirements:

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

SD1760 Workplace Essentials

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

Learning Outcomes:

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

Duration: 45 Hours

Pre-Requisite(s): None

Objectives and Content:

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

1. Identify common practices related to workplace meetings.
 - i. identify and discuss meeting format and preparation required for a meeting
 - ii. explain the purpose of an agenda
 - iii. explain the expected roles, responsibilities, and etiquette of meeting participants

2. Define unions and identify their role in the workplace.
 - i. identify the purpose of unions
 - ii. identify a common union structure
 - iii. identify the function of unions in this trade

3. Demonstrate an understanding of the Worker’s Compensation process.
 - i. describe the aims, objectives, regulations and benefits of the Workplace Health, Safety and Compensation Commission
 - ii. explain the role of the Workers Advisor
 - iii. explain the internal review process

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

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

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

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

Practical Requirements:

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

MC1060 Computer Essentials

Learning Outcomes:

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

Duration: 15 Hours

Pre-Requisite(s): None

Objectives and Content:

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

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

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

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

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

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

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

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

Practical Requirements:

None

BLOCK II Hydrometallurgical Refining

OR2100 Introduction to the Hydrometallurgical Process

Learning Outcomes:

- Demonstrate knowledge of the hydrometallurgical process and describe the advantages and disadvantages of the hydrometallurgical process.
- Demonstrate knowledge of the preparation and handling of metal ore concentrate used in the hydrometallurgical process.
- Demonstrate knowledge of equipment used in the hydrometallurgical process.

Duration: 30Hours

Pre-Requisites: Block I

Objectives and Content:

1. Describe the hydrometallurgical process
 - i. Feed Preparation
 - ii. Pressure Oxidative Leaching
 - iii. Solid/Liquid Separation (CCD)
 - iv. Neutralization
 - v. Water and effluent treatment
 - vi. Cadmium Removal
 - vii. Solvent Extraction
 - viii. Electrowinning
 - ix. Reagents
 - types
 - processes
 - storage
2. Explain the history of the hydrometallurgical process.
3. Explain the advantages and disadvantages of the hydrometallurgical process.
 - i. economics

- ii. environmental
 - iii. energy consumption
 - iv. efficiency
4. Describe various equipment used in the hydrometallurgical process such as:
- i. grinding
 - ii. autoclave
 - iii. thickener/clarifiers
 - iv. mixer/ settlers
 - v. filters
 - vi. electrowinning cells and rectifiers
5. Identify and describe methods of sampling and reporting.
6. Explain the impact and importance of unit costs.
- i. equipment
 - ii. labour
 - iii. operating/auxiliaries
 - iv. maintenance
 - v. consumables
 - vi. power
 - vii. reagents
7. Identify methods of metallurgical accounting and describe their characteristics.
8. Identify methods of Quality Control and describe their characteristics.
- i. customer requirements
 - ii. circuit stabilization, optimization
 - iii. blending, high-grading

Practical Requirements:

None

OR2110 Feed Preparation and Handling

Learning Outcomes:

- Demonstrate knowledge of the principle of operation.
- Demonstrate knowledge of process flow and control.
- Demonstrate knowledge of feed preparation.

Duration: 12 Hours.

Pre-Requisites: Block I

Objectives and Content:

1. Describe the principle of operation for feed preparation and handling.
2. Identify and describe concentrate blending strategies.
3. Describe the objective of feed preparation.
4. Identify the feed, product, and by-product streams.
5. Describe the process flow in feed preparation and handling.
6. Identify the major equipment used in feed preparation.
7. Identify major process variables.
8. Describe safety issues associated with feed preparation.
9. Describe operating procedures associated with feed preparation.

Practical Requirements:

None

OR2120 Neutralization

Learning Outcomes:

- Demonstrate knowledge of the neutralization process.
- Demonstrate knowledge of the principle of operation.
- Demonstrate knowledge of process flow and control.

Duration: 30 Hours

Pre-Requisites: Block I

Objectives and Content:

1. Describe the objectives of weak liquor neutralization (WLN) and first/second stage iron removal.
2. Describe the principle of operation of WLN and first/second stage iron removal circuits.
3. Identify the feed, product, and by-product streams.
4. Describe the chemical principles involved in WLN and first/second stage iron removal.
5. Describe WLN and first/second stage iron removal circuit process flow.
6. Identify the major equipment used in WLN and first/second stage iron removal circuit.
7. Identify major process variables in WLN and first/second stage iron removal circuit.
8. Identify the impact of the process variables on the process in WLN and first/second stage iron removal circuits.

9. Describe safety issues associated with WLN and first/second stage iron removal circuits.
10. Describe operating procedures associated with WLN and first/second stage iron removal circuit.

Practical Requirements:

None

OR2200 Pressure Oxidative Leaching

Learning Outcomes:

- Demonstrate knowledge of the leaching process.
- Demonstrate knowledge of safety issues with leaching.
- Demonstrate knowledge of the principle of operation.
- Demonstrate knowledge of process flow and control.

Duration: 18 Hours

Pre-Requisites: Block I

Objectives and Content:

1. Describe the objectives of leaching.
2. Describe the principle of operation of leaching equipment.
3. Identify the feed, product, and by-product streams.
4. Describe the chemical principles involved in leaching.
5. Describe the process flow in leaching.
6. Identify the major equipment used in leaching.
7. Identify major process variables in leaching.
8. Identify the impacts of the process variables on the process.
9. Describe safety issues associated with leaching.
 - i. oxygen gas
 - ii. steam
 - iii. high pressure
 - iv. high temperature
 - v. acidic solutions

10. Describe operating procedures associated with leaching.
 - i. sampling
 - ii. descaling of autoclave

Practical Requirements:

None

OR2210 Solvent Extraction and Cadmium Removal

Learning Outcomes:

- Demonstrate knowledge of solvent extraction and cadmium removal.
- Demonstrate knowledge of safety issues with solvent extraction and cadmium removal.
- Demonstrate knowledge of the principle of operation.
- Demonstrate knowledge of process flow and control.

Duration: 30 Hours

Pre-Requisites: Block I

Objectives and Content:

1. Describe objectives of solvent extraction and cadmium removal.
2. Describe the principle of operation for solvent extraction and cadmium removal.
3. Identify feed, product, and by-product streams.
4. Describe the chemical principles involved in solvent extraction and cadmium removal.
5. Describe the solvent extraction process flow.
6. Describe the cadmium removal process flow.
7. Identify the major equipment used in solvent extraction and cadmium removal.
8. Identify major process variables with solvent extraction and cadmium removal.
9. Identify the impact of the process variables on the process of solvent extraction and cadmium removal.
10. Describe safety issues associated with solvent extraction and cadmium removal.

11. Describe operating procedures associated with solvent extraction and cadmium removal.

Practical Requirements:

None

OR2220 Electrowinning

Learning Outcomes:

- Demonstrate knowledge of electrowinning.
- Demonstrate knowledge of safety issues with electrowinning.
- Demonstrate knowledge of the principle of operation.
- Demonstrate knowledge of process flow and control.

Duration: 18 Hours

Pre-Requisites: Block I

Objectives and Content:

1. Describe objectives of electrowinning.
2. Describe the principle of operation of electrowinning.
3. Identify the feed, product, and by-product streams.
4. Describe the chemical principles involved in electrowinning.
5. Describe the electrowinning process flow.
6. Identify the major equipment used in electrowinning.
7. Identify major process variables electrowinning.
8. Identify the impact of the process variables on the electrowinning process.
9. Describe safety issues associated with electrowinning.
10. Describe operating procedures associated with electrowinning.
11. Identify and describe the final product packaging and mandrel refurbishment.

12. Describe Quality Control techniques and ISO certification.

Practical Requirements:

None

OR2230 Water, Effluent and Residue Treatment

Learning Outcomes:

- Demonstrate knowledge of the principle of operation.
- Demonstrate knowledge of process flow and control.
- Demonstrate knowledge of feed preparation.

Duration: 12 Hours.

Pre-Requisites: Block I

Objectives and Content:

1. Describe the objectives of water, effluent and residue treatment.
2. Describe the process and principle of operation for treating raw water.
3. Describe the process and principle of operation of effluent treatment.
4. Describe the process and principle of operation of residue (tailings) treatment and deposition.
5. Identify the feed, product, and by-product streams.
6. Describe the chemical principles involved in water, effluent and residue treatment.
7. Identify the major equipment used in water, effluent and residue treatment.
8. Identify major process variables in water, effluent and residue treatment.
9. Identify the impact of the process variables on water, effluent and residue treatment.
10. Describe safety issues associated with water, effluent and residue treatment.

11. Describe operating procedures associated with of water, effluent and residue treatment.
12. Describe government and industry regulations concerning water, effluent and residue treatment.

Practical Requirements:

None

BLOCK II Mineral Processing

OR2300 Mineral Processing I

Learning Outcomes:

- Demonstrate knowledge of milling.
- Demonstrate knowledge of process sampling.
- Demonstrate knowledge of flow-sheets.
- Demonstrate knowledge of sieve analysis.
- Demonstrate knowledge of high tension separation.

Duration: 62 Hours

Pre-Requisites: Block I

Objectives and Content:

1. Describe milling.
2. Explain the process of sampling.
3. Describe sieve analysis.
4. Explain and describe the use of flow-sheets.
5. Describe high tension separation procedure.
6. Describe screening.
 - i. revolving
 - ii. shaking
 - iii. rotary
 - iv. vibrating

7. Describe screening efficiency.
 - i. wet
 - ii. dry screening
8. Describe aspects of capacities in screening.
9. Describe various types and methods of crushing.
 - i. jaw crushers
 - ii. gyratory crushers
 - iii. cone crushers
 - iv. roll crushers
 - v. impactors
10. Describe the aspects of primary and secondary crushing.
11. Describe the various types of feeding methods.
12. Describe the aspects of capacities related to crushing.
13. Describe grinding.
14. Describe types and methods of grinding.
 - i. rod
 - ii. ball
 - iii. pebble mills
 - iv. autogenous
15. Describe various types of grinding media.
16. Describe various types of feeding arrangements.
17. Explain pulp densities and closed versus open circuit.
18. Define the various laws of settling.
19. Describe various hydraulic classifiers.
20. Define and describe cyclones.

21. Describe types of concentration.
 - i. gravity
 - ii. chemical

22. Describe types of separation.
 - i. heavy medium
 - ii. magnetic
 - iii. flotation
 - iv. spirals

23. Describe de-watering.

24. Explain various principles of filtration.

25. Describe the various types of filtration machines.

26. Identify and describe various types of thickeners and their operation.

27. Describe various methods of tailing disposal and environmental impact.

28. Describe tailings dams and their impact on the environment.

29. Describe a water reclamation system.

Practical Requirements:

None

OR2310 Mineral Processing II

Learning Outcomes:

- Demonstrate knowledge of metallurgical accounting.
- Demonstrate knowledge of test procedures/circuits.
- Demonstrate knowledge of quality control.
- Demonstrate knowledge of unit costs.
- Demonstrate knowledge of environmental impacts.

Duration: 18 Hours

Pre-Requisites: Block I

Objectives and Content:

1. Identify methods of metallurgical accounting and describe their characteristics.
 - i. weight yields and mineral recovery
 - two-product formula
 - derivation/function
 - application (single stage/multi stage)
2. Describe the aspects of total plant efficiency/sources of losses.
3. Identify procedures/plans for creating recovery circuits and describe their characteristics.
4. Identify methods of Quality Control and describe their characteristics.
 - iv. customer requirements
 - v. circuit stabilization, optimization
 - vi. blending, high-grading

5. Explain the impact and importance of unit costs.
 - viii. equipment
 - ix. labour
 - x. operating/auxiliaries
 - xi. maintenance
 - xii. consumables
 - xiii. power

6. Describe environmental impact concerns.
 - i. dust in a beneficiation facilities
 - ii. tailings and operating strategies
 - iii. lubricant/spill
 - iv. noise
 - v. local problems/initiatives

7. Define reagents.

8. Describe government and industry initiatives concerning environmental impact.

Practical Requirements:

1. Use spread sheets to help calculate weight yields and percentage recoveries.

2. Construct and explain grade-recovery curves.

OR2320 Mineral Processing III

Learning Outcomes:

- Demonstrate knowledge of agglomerating.
- Demonstrate knowledge of induration.
- Demonstrate knowledge of materials handling.
- Demonstrate knowledge of dust control.
- Demonstrate knowledge of quality control.

Duration: 70Hours

Pre-Requisites: Block I

Objectives and Content:

1. Explain material flow in a feed system.
2. Identify the process to monitor raw material levels in silos in a feed system.
3. Explain how to apply steam to facilitate material flow from silos in a feed system.
4. Describe a closed circuit regrinding process.
5. Explain reasons for regrinding.
6. Explain the operation of the control systems in regrinding.
7. Describe maintaining material flow and storage in regrinding.
8. Describe maintaining an automated regrinding controller.

9. Identify types of pellet plant water systems and describe their applications and procedures for use.
 - i. process water
 - ii. recycled water
 - iii. domestic water
 - iv. fire control water
10. Identify and describe the flotation process.
11. Explain reasons for flotation.
12. Identify government regulations for flotation operations.
13. Explain the operation of the flotation control systems.
14. Explain how to monitor reagent flow levels.
15. Identify the procedure to maintain the ore/reagent mix.
16. Identify and describe the procedure to receive and store reagents.
17. Identify and describe the filtering process.
 - i. reasons for filtering
 - ii. control systems
 - iii. maintenance
18. Describe a closed circuit balling installation.
 - i. ball formation
 - ii. control systems
 - iii. addition of bentonite
19. Identify and describe wet lab sampling procedures.
 - i. filtrate
 - ii. moistures
 - iii. screen analysis
 - iv. compressions

20. Describe the operation of an induration machine.
 - i. burner fuel systems
 - ii. fines return conveyors
 - iii. burner controls
 - iv. change pallets
 - v. operate and control fan floor equipment
 - vi. monitor and maintain equipment
21. Describe the operation of the hearth layer.
22. Identify and describe methods to monitor, control and maintain hearth layer operations.
23. Explain dry lab sampling procedures.
 - i. screening
 - ii. tumbling
24. Identify and describe methods to prepare dry lab samples and reports.
25. Describe bentonite and bentonite plant operation.
 - i. receive crude bentonite
 - ii. storage and distribution of processed bentonite
 - iii. plant control system
26. Explain screen house operation.
 - i. controls
 - ii. operation and maintenance of equipment.
27. Describe procedures to receive and store raw materials in the bulk product handling yard.
 - i. blending
 - ii. distribution process for blended and unblended
28. Identify the process to store and load finished products.
29. Identify and describe methods to sample finished products.

30. Identify and explain dust control systems.
 - i. scrubbers
 - ii. bag house
 - iii. multi-clones
 - iv. weir system

31. Identify and describe procedures in quality control systems.
 - i. Standard Operating Procedures(SOP)
 - ii. International Standards Organization (ISO)
 - iii. Statistical Process Control (SPC)

Practical Requirements:

None

BLOCK III Common Advanced Courses

OR2400 Advanced Control Systems

Learning Outcomes:

- Demonstrate knowledge of programmable logic controller (PLC) systems, their components and operation.
- Demonstrate knowledge of distributed control systems (DCSs), their components and operation.
- Demonstrate knowledge of HMI software and hardware.

Duration: 90 Hours

Pre-Requisite(s): Block II

Objectives and Content:

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
3. Identify PLC system components and describe their purpose and operation.
 - i. hardware
 - ii. software
 - iii. network communication protocols
4. Define terminology associated with DCSs.
5. Identify hazards and describe safe work practices pertaining to DCSs.
6. Identify tools and equipment relating to DCSs and describe their applications and procedures for use.

7. Identify DCS components and describe their purpose and operation.
 - i. hardware
 - ii. software
 - iii. network communication protocols
8. Describe optimization techniques for DCS control loops.
9. Describe types of Operator Interfaces associated with the following hardware:
 - i. operator panels
 - ii. engineering / operator workstations
10. Define generic HMI development terminology, as follows:
 - i. panels and windows
 - ii. objects and symbols
 - iii. connections and links
 - iv. events and alarms
 - v. real-time and historical trending
11. Introduction to different HMI software packages.
 - i. tags
 - define tag types
 - define data sources
 - ii. graphic displays
 - describe graphical displays that include the following objects:
 - buttons
 - indicators
 - gauges
 - navigation
 - define the following:
 - visibility animation
 - motion animation
 - color animation
 - fill animation
 - slider animation
 - iii. trends

12. Define HMI trends.
 - i. define following key concepts of trends:
 - trend object
 - data source
 - pens
 - shading
 - control tags
 - trends X and Y axis
 - ii. configure trends
 - iii. configure pens
 - iv. configure real-time trends
 - v. configure historical trends

13. Alarms.
 - i. define different alarm types
 - ii. define following terms:
 - alarm severity
 - alarm messages
 - alarm log
 - alarm acknowledgement and suppression
 - safety related alarms
 - prioritization of alarms
 - iii. create alarm summary
 - iv. create alarm log file
 - v. define activity logging

14. Security.
 - i. define HMI security
 - ii. analyze security features of HMI software related to user accounts

Practical Requirements:

1. Develop and operate basic HMI application using software.

OR2410 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 process control systems.
- Demonstrate knowledge of the procedures used to commission and optimize process control systems.

Duration: 66 Hours

Pre-Requisite(s): Block II

Objectives and Content:

1. Define terminology associated with advanced process control.
2. Identify hazards and describe safe work practices pertaining to advanced process control.
3. Interpret codes and regulations pertaining to advanced process control.
4. Interpret information pertaining to advanced process control found on drawings and specifications.
5. Explain advanced process control and its purpose.
6. Identify methods of advanced process control and describe their applications.
 - i. ratio
 - ii. feed forward
 - iii. adaptive
7. Explain process loop interactions and their impact on process control.
8. Describe the procedures used to configure and tune process control systems.

9. Describe the procedures used to commission and optimize process control systems.

Practical Requirements:

1. Draw a P & ID for a control loop.

OR2420 Troubleshooting Techniques

Learning Outcomes:

- Demonstrate knowledge of conventional troubleshooting techniques.
- Demonstrate the ability to apply troubleshooting techniques to processes and process equipment.

Pre-requisites: Block II

Duration: 18 Hours

Objectives and Content:

1. Record all information gathered through the troubleshooting process.
2. Describe personal and equipment safety practices.
 - i. energy isolation
 - lockout / tagout
 - OSHA requirements
 - permits
 - ii. personal protective equipment
 - iii. quality of workmanship
3. Describe conventional troubleshooting methods.
 - i. review work order to identify the problem
 - ii. verify the “facts”
 - iii. review the operating sequences of equipment/circuit
 - iv. review equipment manuals, drawings, etc.
 - v. review records / reports describing any changes to equipment/circuit or environment
 - vi. determine equipment/circuit symptoms
 - non-operational (dead)
 - marginal
 - intermittent
 - off specification

- vii. isolate problem
 - dividing method (elimination process)
 - use manufacturer's troubleshooting guide
 - think beyond the "fix" and verify the cause
 - substitution troubleshooting (substitution of components) comparison troubleshooting (compare similar components)
 - sampling as a troubleshooting tool
 - trending

Practical Requirements:

1. Perform simulated troubleshooting exercises on various pieces of process equipment/circuits.

OR2440 Work Planning

Learning Outcomes:

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

Duration: 6 Hours

Pre-Requisite(s): Block I

Objectives and Content:

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

2. Describe the considerations for determining job requirements.
 - i. personnel
 - ii. tools and equipment
 - iii. materials
 - iv. permits
 - v. safety planning
 - vi. risk management
 - vii. communicate effectively (verbal/nonverbal)

3. Describe the procedures used to plan job tasks.

Practical Requirements:

None

B. Conditions Governing Apprenticeship Training

1.0 General

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

2.0 Entrance Requirements

2.1 Entry into the occupation as an apprentice requires:

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

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

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

2.4 An Application for Apprenticeship form must be duly completed along with a Memorandum of Understanding as applicable to be indentured into an Apprenticeship. The Memorandum of Understanding must contain signatures of an authorized employer representative, the apprentice and an official representing the Provincial Apprenticeship and Certification Board to be valid.

- 2.5 A new Memorandum of Understanding must be completed for each change in an employer during the apprenticeship term.

3.0 Probationary Period

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

4.0 Termination of a Memorandum of Understanding

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

5.0 Apprenticeship Progression Schedule, Wage Rates and Advanced Training Criteria

Progression Schedule, Wage Rate and Advanced Training Criteria are stated in the specific occupational Plan of Training for each designated apprenticeship occupation.

Progression Schedule

Process Operator - 5400 Hours			
APPRENTICESHIP LEVEL AND WAGES			
Year	Wage Rate At This Level	Requirements for progression to next level of apprenticeship	When requirements are met, the apprentice will progress to...
1 st	60 %	<ul style="list-style-type: none"> ▪ Completion of Block 1 training ▪ Pass Block 1 exam ▪ Minimum 1800 hours of combined relevant work experience and training 	2 nd Year
2 nd	75%	<ul style="list-style-type: none"> ▪ Completion of Block 2 training ▪ Pass Block 2 exam ▪ Minimum 3600 hours of combined relevant work experience and training 	3 rd Year
3 rd	90%	<ul style="list-style-type: none"> ▪ Completion of Block 3 training ▪ Minimum 5400 hours of combined relevant work experience and training ▪ Sign-off of all workplace skills in apprentice logbook ▪ Pass certification exam 	Journeyperson Certification
<p>Wage Rates</p> <ul style="list-style-type: none"> ▪ Rates are percentages of the prevailing journeyperson’s wage rate in the place of employment of the apprentice. ▪ Rates must not be less than the wage rate established by the Labour standards Act (1990), as now in force or as hereafter amended, or by other order, as amended from time to time replacing the first mentioned order. ▪ Rates must not be less than the wage rate established by any collective agreement which may be in force at the apprentice’s workplace. ▪ Employers are free to pay wage rates above the minimums specified. <p>Block Exams</p> <ul style="list-style-type: none"> ▪ This program may not currently contain block exams, in which case this requirement will be waived until such time as block exams are available. 			

Process Operator - 5400 Hours		
CLASS CALLS		
Call Level	Requirements for Class Call	Hours awarded for In-School Training
Direct Entry Apprentice: PLA & / or Block 1	<ul style="list-style-type: none"> ▪ Minimum of 1000 hours of relevant work experience and training ▪ Prior Learning Assessment (PLA) at designated college (if applicable) 	To be determined by the number of courses completed after each class call
Block 2	<ul style="list-style-type: none"> ▪ Minimum of 2500 hours of relevant work experience and training 	150
Block 3	<ul style="list-style-type: none"> ▪ Minimum of 5220 hours of relevant work experience and training 	180
<p>Direct Entry Apprentice:</p> <ul style="list-style-type: none"> ▪ Must complete Block 1 courses through PLA and / or in school training. ▪ Block 1 training is to be completed via class calls; up to 16 weeks of training per calendar year. ▪ Must attend in-school training until Block 1 is complete before attending Blocks 2 or higher. <p>Class calls at Minimum Hours:</p> <ul style="list-style-type: none"> ▪ Class calls may not always occur at the minimum hours indicated. Some variation is permitted to allow for the availability of training resources and apprentices. 		

6.0 Tools

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

7.0 Periodic Examinations and Evaluation

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

8.0 Granting of Certificates of Apprenticeship

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

9.0 Hours of Work

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

10.0 Copies of the Registration for Apprenticeship

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

11.0 Ratio of Apprentices to Journeypersons

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

12.0 Relationship to a Collective Bargaining Agreement

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

13.0 Amendments to a Plan of Apprenticeship Training

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

14.0 Employment, Re-Employment and Training Requirements

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

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

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

15.0 Appeals to Decisions Based on Conditions Governing Apprenticeship Training

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

C. Requirements for Provincial Certification

1. Evidence the required work experiences outlined in this Plan of Training have been obtained. This evidence must be in a format clearly outlining the experiences and must be signed by an appropriate person or persons attesting that these experiences have been obtained to the level required.
2. Successful completion of all required courses in the program.
3. A combination of training from an approved training program and suitable work experience totaling 5400 hours.

Or

A total of 7200 hours of suitable work experience.

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

D. Roles and Responsibilities of Stakeholders in the Apprenticeship Process

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

The Apprentice:

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

The Employer:

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

The Training Institution:

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

The Apprenticeship and Trades Certification Division:

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

The Provincial Apprenticeship and Certification Board:

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