Plan of Training

Machinist

Newfoundland Labrador

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

March 2012

PLAN OF TRAINING

Machinist

March 2012

Newfoundland Labrador

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

Approved by:

Chairperson, Provincial Apprenticeship and Certification Board

Date: March 13/12

Preface

This Apprenticeship Standard is based on the 2010 edition of the National Occupational Analysis for the Machinist trade.

This document describes the curriculum content for the Machinist 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.

Contact Information

Department of Advanced Education and Skills
Apprenticeship and Trades Certification Division
Tel: 709-729-2729 / 1-877-771-3737
Email: app@gov.nl.ca
Web: www.gov.nl.ca/app

Document Status	Date Approved	Mandatory Implementation Date	Comments
Updated December 2012	March 2012	September 2012	Updated related suite

Table of Contents

A. Profile Chart 4

B. NOA Comparison Table 6

C. Program Structure 13

BLOCK I 17

TS1510 Occupational Health and Safety 17
TS1520 Workplace Hazardous Materials Information System (WHMIS) 20
TS1530 Standard First Aid 23
MW1190 Machine Shop Safety 24
MW1370 Basic Layout 26
MW1380 Hand and Power Tools 28
MW1390 Hand Threading and Reaming 30
MW1761 Precision Measurement I 33
MW1771 Basic Drawings 36
MW1781 Cutting Fluids, Coolants, Lubricants and Solvents 38
MW1791 Machinable Materials 41
MW1801 Precision Measurement II 44
MW2300 Power Sawing Equipment 46
MW2310 Introduction to Grinding and Abrasives 49
MW2370 Material Testing 51
MW2320 Heat Treatment 53
MW1841 Hoisting, Lifting and Rigging 55
MW1851 Drills and Drill Presses 57
MW1861 Introduction to Conventional Lathes 63
MW1871 Basic Conventional Lathe Operation 68
MW1881 Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading 71
MW1900 Taper Turning 73
MW1911 Basic Threading 75
MW1921 Introduction to Milling Machines 78
MW1951 Reciprocating Machines 82
MW1961 Machine Cutting Tools 85
MW2061 Computer Numerical Control (CNC) Machine-Tools 87
MW2071 Computer Numerical Control (CNC) Operation 1 89
MW2081 Mechanical Components 91
MW2121 Oxy Fuel Welding and Cutting 94
MW2340 Reconditioning 97
AP1101 Introduction to Apprenticeship 99
AM1100 Math Essentials 103
AM1180 Industrial Math Fundamentals 105
CM2160 Communication Essentials 107
SD1760 Workplace Essentials 110
MC1060 Computer Essentials 113

BLOCK II 116
MW1811 Advanced Drawings 116
MW2350 Precision Layout 118
MW2360 Horizontal/Universal Milling Machine Operation 120
MW1931 Advanced Conventional Lathe Operation 123
MW1941 Job Planning 126
MW1991 Quality Inspection 128

BLOCK III 130
MW1981 Gears and Gear Cutting 130
MW2000 Vertical Milling Machine Operation 133
MW2010 Boring Mills 136
MW2021 Abrasive Finishing 137
MW2031 Cylindrical Grinders 140
MW2041 Cutter and Tool Grinder 142
MW2101 Surface Grinders 144

BLOCK IV 147
MW2090 Bevel, Helical and Worm Gears 147
MW2110 Electrical Arc Welding 149
MW2141 Computer Numerical Control (CNC) Operation 2 152

D. Conditions Governing Apprenticeship Training 155

E. Requirements for Red Seal Endorsement 162

F. Roles and Responsibilities of Stakeholders in the Apprenticeship Process. 163

A. Profile Chart

OCCUPATIONAL SKILLS			
MW1190 Machine Shop Safety	**MW1841** Hoisting, Lifting and Rigging	**MW1771** Basic Drawings	**MW1811** Advanced Drawings
MW1390 Hand Threading and Reaming	**MW1781** Cutting Fluids, Coolants, Lubricants and Solvents	**MW2081** Mechanical Components	**MW1791** Machinable Materials
MW2320 Heat Treatment	**MW2370** Material Testing	**MW1941** Job Planning	**MW2340** Reconditioning
MW2121 Oxy Fuel Cutting and Welding	**MW2110** Electrical Arc Welding		
TOOLS			
MW1380 Hand and Power Tools	**MW2300** Power Sawing Equipment	**MW1961** Cutting Machine Tools	**MW1851** Drills and Drill Presses
MW1951 Reciprocating Machines	**MW1911** Basic Threading	**MW2041** Cutter and Tool Grinder	
LAYOUT AND MEASUREMENT			
MW1761 Precision Measurement I	**MW1801** Precision Measurement II	**MW1370** Basic Layout	**MW2350** Precision Layout
MW1991 Quality Inspection			
LATHES			
MW1861 Introduction to Conventional Lathes	**MW1871** Basic Conventional Lathe Operation	**MW1881** Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading	**MW1931** Advanced Conventional Lathe Operation
MW1900 Taper Turning			

MILLING MACHINES			
MW1921 Introduction to Milling Machines	**MW2000** Vertical Milling Machine Operation	**MW2360** Horizontal/Universal Milling Machine Operation	**MW1981** Gears and Gear Cutting
MW2090 Bevel, Helical and Worm Gears	**MW2010** Boring Mills		
GRINDERS			
MW2310 Introduction to Grinding and Abrasives	**MW2021** Abrasive Finishing	**MW2101** Surface Grinders	**MW2031** Cylindrical Grinders
COMPUTER NUMERICAL CONTROL (CNC) MACHINES			
MW2061 Computer Numerical Control (CNC) Machine-Tools	**MW2071** Computer Numerical Control (CNC) Operation 1	**MW2141** Computer Numerical Control (CNC) Operation 2	

B. NOA Comparison Table

2010 NOA Tasks and Sub-task		2012 POT	
Task 1 – Organizes work.			
1.01	Interprets documentation.	MW1771	Basic Drawings
		MW1811	Advanced Drawings
		MW1941	Job Planning
1.02	Plans sequence of operation.	MW1941	Job Planning
1.03	Maintains safe work environment.	MW1190	Machine Shop Safety
1.04	Uses personal protective equipment (PPE) and safety equipment.	MW1190	Machine Shop Safety
1.05	Uses hoisting, lifting and rigging equipment.	MW1841	Hoisting, Lifting and Rigging
Task 2 – Processes workpiece material.			
2.01	Selects workpiece material.	MW1791	Machinable Materials
2.02	Performs layout	MW1370	Basic Layout
		MW2350	Precision Layout
2.03	Marks workpiece for identification.	MW1370	Basic Layout
		MW1791	Machinable Materials
2.04	Performs basic heat treatment.	MW2320	Heat Treatment
2.05	Tests workpiece materials.	MW2320	Heat Treatment
		MW2370	Material Testing
		MW1991	Quality Inspection
2.06	Deburrs workpiece.	MW1380	Hand and Power Tools
2.07	Sketches parts.	MW1771	Basic Drawings
Task 3 – Maintains machines and tooling.			
3.01	Cleans machines.	MW1781	Cutting Fluids, Coolants, Lubricants and Solvents
		MW1871	Basic Conventional Lathe Operation
		MW2000	Vertical Milling Machine Operation
		MW2360	Horizontal/Universal Milling Machine Operation
3.02	Lubricates machines.	MW1781	Cutting Fluids, Coolants, Lubricants and Solvents
		MW1871	Basic Conventional Lathe Operation
		MW2000	Vertical Milling Machine Operation
		MW2360	Horizontal/Universal Milling Machine Operation
3.03	Sharpens tooling.	MW1861	Introduction to Conventional Lathes
		MW1961	Cutting Machine Tools
		MW2041	Cutter and Tool Grinder
3.04	Applies cutting fluids and coolants.	MW1781	Cutting Fluids, Coolants, Lubricants and Solvents
		MW1871	Basic Conventional Lathe Operation

2010 NOA Tasks and Sub-task		2012 POT	
3.05	Troubleshoots equipment.	MW1871	Basic Conventional Lathe Operation
		MW2000	Vertical Milling Machine Operation
		MW2360	Horizontal/Universal Milling Machine Operation
		MW2101	Surface Grinders
		MW2031	Cylindrical Grinders
3.06	Maintains machine alignment.	MW1871	Basic Conventional Lathe Operation
		MW2000	Vertical Milling Machine Operation
3.07	Maintains inspection equipment.	MW1761	Precision Measurement I
		MW1991	Quality Inspection
Task 4 – Performs hand processes.			
4.01	Files workpiece.	MW1380	Hand and Power Tools
4.02	Saws workpiece.	MW2300	Power Sawing Equipment
4.03	Performs hole-making operations.	MW1881	Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading
4.04	Performs threading operations.	MW1390	Hand Threading and Reaming
		MW1881	Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading
		MW1931	Advanced Conventional Lathe Operation
		MW1911	Basic Threading
4.05	Installs thread inserts.	MW1390	Hand Threading and Reaming
		MW2340	Reconditioning
4.06	Broaches workpiece.	MW2081	Mechanical Components
		MW1951	Reciprocating Machines
4.07	Performs pressing operations.	MW1380	Hand and Power Tools
		MW2340	Reconditioning
4.08	Bends workpiece.	MW2110	Electrical Arc Welding
		MW2121	Oxy Fuel Cutting and Welding
4.09	Finishes workpiece.	MW2021	Abrasive Finishing
Task 5 – Refurbishes components.			
5.01	Disassembles components.	MW2340	Reconditioning
5.02	Analyzes components.	MW2340	Reconditioning
5.03	Assembles components.	MW2340	Reconditioning
Task 6 – Sets up drill presses.			
6.01	Selects drill press types.	MW1851	Drills and Drill Presses
6.02	Plans drill press sequence.	MW1851	Drills and Drill Presses
6.03	Selects drill press speeds and feeds.	MW1851	Drills and Drill Presses
6.04	Sets up jigs, fixtures and work holding devices for drill presses.	MW2340	Reconditioning
		MW1851	Drills and Drill Presses
6.05	Sets up tooling for drill presses.	MW1851	Drills and Drill Presses

2010 NOA Tasks and Sub-task		2012 POT	
Task 7 – Operates drill presses.			
7.01	Drills holes using a drill press.	MW1851	Drills and Drill Presses
7.02	Cuts countersinks, counterbores, chamfers and spot faces using a drill press.	MW1851	Drills and Drill Presses
7.03	Performs tapping using a drill press.	MW1851	Drills and Drill Presses
7.04	Finishes holes using a drill press.	MW1851	Drills and Drill Presses
Task 8 – Sets up conventional lathes.			
8.01	Selects conventional lathe types.	MW1861	Introduction to Conventional Lathes
8.02	Plans sequence of operations for conventional lathes.	MW1871	Basic Conventional Lathe Operation
8.03	Sets up work holding devices for conventional lathes.	MW1871	Basic Conventional Lathe Operation
8.04	Sets up tooling for conventional lathes.	MW1871	Basic Conventional Lathe Operation
8.05	Sets up conventional lathe accessories.	MW1871	Basic Conventional Lathe Operation
8.06	Sets up workpiece on conventional lathe.	MW1871	Basic Conventional Lathe Operation
8.07	Selects conventional lathe speeds and feeds.	MW1871	Basic Conventional Lathe Operation
8.08	Sets up eccentrics on conventional lathes.	MW1871	Basic Conventional Lathe Operation
		MW1931	Advanced Conventional Lathe Operation
Task 9 – Operates conventional lathes.			
9.01	Turns external surfaces using a conventional lathe.	MW1871	Basic Conventional Lathe Operation
9.02	Bores holes using a conventional lathe.	MW1871	Basic Conventional Lathe Operation
		MW1881	Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading
9.03	Faces surfaces using a conventional lathe.	MW1871	Basic Conventional Lathe Operation
9.04	Turns tapers on a conventional lathe.	MW1900	Taper Turning
9.05	Knurls using a conventional lathe.	MW1871	Basic Conventional Lathe Operation
9.06	Parts off workpiece using a conventional lathe.	MW1871	Basic Conventional Lathe Operation
9.07	Drills using a conventional lathe.	MW1881	Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading
9.08	Reams holes using a conventional lathe.	MW1871	Basic Conventional Lathe Operation
		MW1881	Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading
9.09	Cuts grooves using a conventional lathe.	MW1871	Basic Conventional Lathe Operation
9.10	Cuts threads using a conventional lathe.	MW1871	Basic Conventional Lathe Operation
		MW1931	Advanced Conventional Lathe Operation

2010 NOA Tasks and Sub-task		2012 POT	
Task 10 – Sets up conventional milling machines.			
10.01	Selects conventional milling machine types.	MW1921	Introduction to Milling Machines
10.02	Plans milling sequence.	MW2000	Vertical Milling Machine Operation
		MW2360	Horizontal/Universal Milling Machine Operation
10.03	Sets up work holding devices for conventional milling machines.	MW2000	Vertical Milling Machine Operation
		MW2360	Horizontal/Universal Milling Machine Operation
10.04	Sets up tooling for conventional milling machines.	MW2000	Vertical Milling Machine Operation
		MW2360	Horizontal/Universal Milling Machine Operation
10.05	Sets up milling accessories.	MW2000	Vertical Milling Machine Operation
		MW2360	Horizontal/Universal Milling Machine Operation
10.06	Sets up workpiece on a conventional milling machine.	MW2000	Vertical Milling Machine Operation
		MW2360	Horizontal/Universal Milling Machine Operation
10.07	Selects conventional milling machine speeds and feeds.	MW2000	Vertical Milling Machine Operation
		MW2360	Horizontal/Universal Milling Machine Operation
Task 11 – Operates conventional milling machines.			
11.01	Mills surfaces using a conventional milling machine.	MW2000	Vertical Milling Machine Operation
		MW2360	Horizontal/Universal Milling Machine Operation
11.02	Mills profiles and pockets using a conventional milling machine.	MW2000	Vertical Milling Machine Operation
		MW2360	Horizontal/Universal Milling Machine Operation
11.03	Mills slots, grooves and keyways using a conventional milling machine.	MW2000	Vertical Milling Machine Operation
		MW2360	Horizontal/Universal Milling Machine Operation
11.04	Cuts gears and splines using a conventional milling machine.	MW2000	Vertical Milling Machine Operation
		MW2360	Horizontal/Universal Milling Machine Operation
		MW1981	Gears and Gear Cutting
		MW2090	Bevel, Helical and Worm Gears
11.05	Drills holes using a conventional milling machine.	MW2000	Vertical Milling Machine Operation
		MW1981	Gears and Gear Cutting
		MW2090	Bevel, Helical and Worm Gears
11.06	Reams holes using a conventional milling machine.	MW2000	Vertical Milling Machine Operation
		MW2360	Horizontal/Universal Milling Machine Operation

2010 NOA Tasks and Sub-task		2012 POT	
11.07	Cuts countersinks, counterbores, chamfers and spot faces using a conventional milling machine.	MW2000	Vertical Milling Machine Operation
11.08	Performs tapping using a conventional milling machine.	MW2000	Vertical Milling Machine Operation
		MW2000	Vertical Milling Machine Operation
11.09	Bores holes using a conventional milling machine.	MW2000	Vertical Milling Machine Operation
Task 12 – Sets up power saws.			
12.01	Selects power saw types.	MW2300	Power Sawing Equipment
12.02	Selects saw blades.	MW2300	Power Sawing Equipment
12.03	Installs saw blades.	MW2300	Power Sawing Equipment
12.04	Selects power saw speeds and feeds.	MW2300	Power Sawing Equipment
12.05	Makes power saw adjustments.	MW2300	Power Sawing Equipment
12.06	Sets up workpiece on power saw.	MW2300	Power Sawing Equipment
Task 13 – Operates power saws.			
13.01	Saws straight and angle cuts.	MCH 230	Power Sawing Equipment
		MW2300	Power Sawing Equipment
Task 14 – Sets up precision grinding machines.			
14.01	Selects precision grinding machine types.	MW2310	Introduction to Grinding and Abrasives
14.02	Plans grinding sequence.	MW2101	Surface Grinders
14.03	Sets up work holding devices for precision grinding machines.	MW2101	Surface Grinders
		MW2031	Cylindrical Grinders
14.04	Mounts grinding wheel.	MW2021	Abrasive Finishing
14.05	Sets up grinding accessories.	MW2101	Surface Grinders
		MW2031	Cylindrical Grinders
14.06	Sets up workpiece on precision grinding machines.	MW2101	Surface Grinders
		MW2031	Cylindrical Grinders
14.07	Selects precision grinding machine speeds and feeds.	MW2101	Surface Grinders
		MW2031	Cylindrical Grinders
Task 15 – Operates precision grinding machines.			
15.01	Grinds flat surfaces using a surface grinder.	MW2101	Surface Grinders
		MW2031	Cylindrical Grinders
15.02	Grinds profiles.	MW2101	Surface Grinders
		MW2031	Cylindrical Grinders
15.03	Grinds internal and external cylindrical and tapered surfaces.	MW2031	Cylindrical Grinders
15.04	Grinds tools and cutters.	MW2021	Abrasive Finishing
		MW2031	Cylindrical Grinders
15.05	Finishes holes using a honing machine.	MW2021	Abrasive Finishing

2010 NOA Tasks and Sub-task		2012 POT	
Task 16 – Performs basic CNC programming.			
16.01	Reviews process documentation.	MW2071	Computer Numerical Control (CNC) Operation 1
		MW2141	Computer Numerical Control (CNC) Operation 2
16.02	Calculates coordinates for tool path.	MW2101	Surface Grinders
		MW2071	Computer Numerical Control (CNC) Operation 1
		MW2071	Computer Numerical Control (CNC) Operation 1
16.03	Creates basic program.	MW2141	Computer Numerical Control (CNC) Operation 2
16.04	Inputs program data into control memory.	MW2071	Computer Numerical Control (CNC) Operation 1
		MW2141	Computer Numerical Control (CNC) Operation 2
16.05	Optimizes program.	MW2071	Computer Numerical Control (CNC) Operation 1
		MW2141	Computer Numerical Control (CNC) Operation 2
Task 17 – Sets up CNC machine-tools.			
17.01	Selects tooling and tool holders for CNC machine-tools.	MW2061	Computer Numerical Control (CNC) Machine-Tools
17.02	Sets up tooling and tool holders for CNC machine-tools.	MW2071	Computer Numerical Control (CNC) Operation 1
		MW2141	Computer Numerical Control (CNC) Operation 2
17.03	Sets up workpiece on CNC machine-tool.	MW2071	Computer Numerical Control (CNC) Operation 1
		MW2141	Computer Numerical Control (CNC) Operation 2
17.04	Establishes work datum.	MW2071	Computer Numerical Control (CNC) Operation 1
		MW2141	Computer Numerical Control (CNC) Operation 2
17.05	Verifies program.	MW2071	Computer Numerical Control (CNC) Operation 1
		MW2141	Computer Numerical Control (CNC) Operation 2
Task 18 – Operates CNC machine-tools.			
18.01	Adjusts offsets.	MW2071	Computer Numerical Control (CNC) Operation 1
		MW2141	Computer Numerical Control (CNC) Operation 2

2010 NOA Tasks and Sub-task		2012 POT	
18.02	Monitors machining processes.	MW2071	Computer Numerical Control (CNC) Operation 1
		MW2141	Computer Numerical Control (CNC) Operation 2
18.03	Interrupts program cycle.	MW2071	Computer Numerical Control (CNC) Operation 1
		MW2141	Computer Numerical Control (CNC) Operation 2
18.04	Restarts program cycle.	MW2071	Computer Numerical Control (CNC) Operation 1
		MW2141	Computer Numerical Control (CNC) Operation 2

C. Program Structure

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

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 1				
NL Course No.	**IPG Course No.**	**Course Name**	**Pre-Requisite(s)**	**Duration**
TS1510	--	Occupational Health & Safety		6
TS1520	--	WHMIS		6
TS1530	--	Standard First Aid		14
MW1190	MCH-100	Machine Shop Safety		15
MW1370	MCH-130	Basic Layout	MW1190	15
MW1380	MCH-120	Hand and Power Tools	MW1190	30
MW1390	MCH-125	Hand Threading and Reaming	MW1190	30
MW1761	MCH-115	Precision Measurement I	MW1190	30
MW1771	MCH-110	Basic Drawings	MW1190	30
MW1781	MCH-135	Cutting Fluids, Coolants, Lubricants and Solvents	MW1190	15
MW1791	MCH-300	Machinable Materials	MW1190	9
MW1801	MCH-210	Precision Measurement II	MW1190	30
MW2300	MCH-230 MCH-235	Power Sawing Equipment	MW1190	30
MW2310	MCH-145	Introduction to Grinding and Abrasives	MW1190	15

Block 1				
NL Course No.	**IPG Course No.**	**Course Name**	**Pre-Requisite(s)**	**Duration**
MW2370	MCH-305	Material Testing	MW1190	15
MW2320	MCH-250	Heat Treatment	MW1190, MW2370	15
MW1841	MCH-105	Hoisting, Lifting and Rigging	MW1190	15
MW1851	MCH-140	Drills and Drill Presses	MW1190	45
MW1861	MCH-150	Introduction to Conventional Lathes	MW1190	45
MW1871	MCH-155	Basic Conventional Lathe Operation	MW1190, MW1861	60
MW1881	MCH-160	Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading	MW1190, MW1871	30
MW1900	MCH-225	Taper Turning	MW1190, MW1881	30
MW1911	--	Basic Threading	MW1190, MW1881	60
MW1921	MCH-165	Introduction to Milling Machines	MW1190	72
MW1951	MCH-320	Reciprocating Machines	MW1190	45
MW1961	MCH-215	Machine Cutting Tools	MW1190	15
MW2061	MCH-410	Computer Numerical Control (CNC) Machine-Tools	MW1190	15
MW2071	MCH-415	Computer Numerical Control (CNC) Operation 1	MW1190	45
MW2081	MCH-240	Mechanical Components	MW1190	15
MW2121	--	Oxy Fuel Cutting and Welding	MW1190	30
MW2340	MCH-420	Reconditioning	MW1190	15
AM1100	-	Math Essentials	-	30
AM1180	-	Industrial Math Fundamentals	-	30
CM2160	-	Communication Essentials	-	45
SD1760	-	Workplace Essentials	-	45

Block 1				
NL Course No.	**IPG Course No.**	**Course Name**	**Pre-Requisite(s)**	**Duration**
MC1060	-	Computer Essentials	-	15
AP1101	-	Introduction to Apprenticeship	-	15
			Total Hours	1022

Required Work Experience

Block 2				
NL Course No.	**IPG Unit**	**Course Name**	**Pre-Requisites**	**Duration**
MW1811	MCH-205	Advanced Drawings	Block I	30
MW2350	MCH-340	Precision Layout	Block I	30
MW2360	MCH-310	Horizontal/Universal Milling Machine Operation	Block I	45
MW1931	MCH-220	Advanced Conventional Lathe Operation	Block I	105
MW1941	MCH-400	Job Planning	Block I	15
MW1991	MCH-405	Quality Inspection	Block I	15
			Total Hours	**240**

Required Work Experience

Block 3				
NL Course No.	**IPG Unit**	**Course Name**	**Pre-Requisites**	**Duration**
MW1981	MCH-315	Gears and Gear Cutting	Block II	45
MW2000	MCH-200	Vertical Milling Machine Operation	Block II	85
MW2010	--	Boring Mills	Block II	5
MW2021	MCH-325	Abrasive Finishing	Block II	10
MW2031	MCH-335	Cylindrical Grinders	Block II	35
MW2041	--	Cutter and Tool Grinder	Block II	20
MW2101	MCH-330	Surface Grinders	Block II	40
			Total Hours	**240**

Required Work Experience

Block 4				
NL Course No.	**IPG Unit**	**Course Name**	**Pre-Requisites**	**Duration**
MW2090	--	Bevel, Helical and Worm Gears	Block III	95
MW2110	--	Electrical Arc Welding	Block III	45
MW2141	--	Computer Numerical Control (CNC) Operation 2	Block III	100
			Total Hours	**240**

Total Course Credit Hours	**1742**

***A student who can meet the Mathematics requirement through an ACUPLACER® test may be exempted from Mathematics 1060. Please check with your training institution.**

BLOCK I

TS1510 Occupational Health and Safety

Learning Outcomes:

- Demonstrate knowledge of how to prevent accidents and illnesses.
- Demonstrate knowledge of how to improve health and safety conditions in the workplace.

Duration: 6hrs

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 hrs

Pre-requisite(s): None

Objectives and Content:

1. Define WHMIS safety.
   - i. rational and key elements
   - ii. history and development of WHIMIS
   - 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

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

Duration: 14 hrs

Pre-requisite(s): None

MW1190 Machine Shop Safety

Learning Outcomes:

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

Duration: 15 Hours

Pre-requisite(s): None

Objectives and Content:

1. Identify types of personal protective equipment (PPE) and describe their applications.
   i. vision
   ii. hearing
   iii. clothing
   iv. footwear
   v. respiratory

2. Describe the procedures used to care for and maintain PPE.

3. Identify types of fire extinguishing equipment and describe their applications and procedures for use.

4. Explain Fire regulations.
   i. alarms and evacuation procedures
   ii. fire exits
   iii. extinguishers

5. Identify workplace hazards and describe safe work practices and equipment.
   i. personal
   ii. shop/facility
      - energy state awareness (electrical and mechanical)
      - lockout / tag out
      - ventilation/fumes
      - fire

iii environment
iv discharge/spills

6. Explain the importance of conducting safety inspections of shops.

Practical Requirements:

1. Perform a safety inspection of the machine shop.

2. Instructor and students to discuss as a group the findings of the safety inspection.

MW1370 Basic Layout

Learning Outcome:

- Demonstrate knowledge of basic layout and its use.
- Demonstrate knowledge of basic layout tools and equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of the procedures used to perform a basic layout.

Duration: 15 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with basic layout.

2. Identify types of basic layout tools, equipment and accessories and describe their applications and procedures for use.
   i. angle plates
   ii. scribers
   iii. dividers and trammels
   iv. hermaphrodite calipers
   v. squares(adjustable, solid, master)
   vi. gauges
   vii. steel rules
   viii. prick punch
   ix. centre punch
   x. automatic centre punch
   xi. layout tables
   xii. surface plates
   xiii. combination set
   xiv. surface gauge
   xv. calipers (inside and outside)

3. Identify types of layout media/solutions and describe their applications.

4. Calculate layout dimensions and reference points.

5. Describe the procedures used to read and transfer sizes from a drawing.

6. Describe the procedures used to perform a basic layout.

7. Identify methods used to mark workpieces for identification and describe their associated procedures.

8. Describe the procedures used to inspect, maintain and store layout tools and equipment.

9. Identify accessories for layout work and describe their applications and procedures for use.
   i. angle plate
   ii. tool makers clamp
   iii. parallels
   iv. v-blocks
   v. keyseat rules

10. Describe datum or reference surfaces, their purpose and applications.

11. Describe the procedures used to perform accurate layout of work on a flat surface.

Practical Requirements:

1. Select and apply layout coatings

2. Layout work from blueprints

3. Perform basic layout procedure to an accuracy of 1/64 inch

MW1380 Hand and Power Tools

Learning Outcomes:

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

Duration: 30 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to hand and power tools.

HAND TOOLS

2. Identify types of hand tools and describe their applications and procedures for use.
    - i. vises
        - parts
        - sizing methods
        - mounting procedures
        - work holding methods
        - special vises
    - ii. hammers
    - iii. screw drivers
    - iv. wrenches
        - metric and imperial sizing systems
    - v. pliers
    - vi. punches
        - dressing procedures
    - vii. stamps
        - parts
    - viii. hacksaws
        - parts

ix. files
x. scrapers
xi. deburring tools

3. Describe the procedures used to inspect, maintain and store hand tools.

4. Identify types of power tools and equipment and describe their applications and procedures for use.
   i. electrical
      - portable bandsaw
      - hand grinders
   ii. cordless
      - drill
      - reciprocating saw
      - circular saw
   iii. hydraulic
      - press
      - jacks
   iv. pneumatic
      - die grinder
      - impact tools
      - blow gun

5. Describe the procedures used to inspect, maintain and store power tools and equipment.

Practical Requirements:

1. Use various hand tools.

2. Draw file a flat surface.

3. Cut various material using a hacksaw.

4. Select various power tools for various applications.

MW1390 Hand Threading and Reaming

Learning Outcomes:

- Demonstrate knowledge of basic threads and fits and their applications.
- Demonstrate knowledge of the procedures used to measure and gauge threads.
- Demonstrate knowledge of procedures used to produce and restore internal and external threads.

Duration: 30 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with threads.

2. Identify hazards and describe safe work practices pertaining to threads.

3. Identify types of threads and describe their purpose and applications.

4. Explain thread fit, classifications and series.

5. Identify types of thread inserts and describe their applications and installation procedures.

6. Describe the importance of thread fit and the use of thread gauges.

7. Identify types of thread failures and describe their causes and remedies.

8. Calculate and select tap drill sizes in metric and imperial charts.

9. Identify methods used to measure and gauge threads and describe their associated procedures.

TAPS AND DIES

10. Describe the procedures used to produce threads using taps and dies.

11. Describe the different thread types and number taps and their applications.

12. Describe tap failures and remedies.

13. Describe the procedures for using tap extractors.

14. Describe the function of lubricants and the importance of selecting the lubricant.

15. Describe the different types of imperial and metric dies, their applications and use.

16. Describe the procedures used for the installation and use of tap drills.
    i. dies
    ii. extractors
    iii. helicoils

17. Describe the procedures used to restore threads with taps and dies.

18. Describe the procedures used to calculate tap drill sizes.

HAND REAMERS

19. Identify reamers and describe their characteristics and applications.
    i. maintenance
    ii. storage

20. Describe the procedures used to perform hand reaming.

Practical Requirements:

1. Thread studs using dies.

2. Restore internal threads with a tap.

3. Hand ream a hole.

MW1761 Precision Measurement I

Learning Outcomes:

- Demonstrate knowledge of basic precision measurement and its use.
- Demonstrate knowledge of basic precision measuring instruments, their applications and procedures for use.

Duration: 30 Hours

Pre-requisite(s): MW1190

Objectives and Content:

APPLIED MATHEMATICS

1. Perform accurate mathematical calculations using fractions.

2. Perform calculations and conversions using the metric and imperial systems.

3. Read measurements using metric and imperial systems.

4. Perform calculations for angular measurement.

BASIC MEASUREMENT

5. Define terminology associated with basic precision measurement.

6. Describe the imperial and metric measuring systems and the procedures used to perform conversions for machining operations.

7. Describe the procedures used to read basic precision measuring instrument scales.

8. Identify types of precision measuring instruments and describe their applications and procedures for use.
   i. micrometers
   ii. vernier calipers
   iii. dial indicators
   iv. radius gauges

v. combination sets
vi. plug gauges
vii. tool makers' buttons
viii. telescopic gauges
ix. feeler gauges
x. go-no go gauges
xi. wigglers
xii. angle gauges
xiii. small hole gauges
xiv. solid square
xv. thread gauges
xvi. spring and firm-joint calipers
xvii. depth and height gauges
xviii. steel rules
xix. machinist levels
xx. master height gauge

9. Identify types of micrometer and describe their characteristics, applications, and procedures for use.
   i. adjustment
   ii. care and maintenance

10. Describe the procedures used to perform basic calibration of measuring instruments.

11. Describe procedures used to inspect, clean, maintain and store basic precision measuring instruments.

12. Identify types of squares and describe their applications and procedures for use.

13. Identify surface plates and granite tables and describe the procedures for their use and care.

14. Describe the procedures used for transfer of sizes.

Practical Requirements:

1. Perform micrometer adjustments, proper care and storage of micrometers.

2. Perform correct transfer of sizes.

3. Perform measurement of height and depth to an accuracy of .001 inch using a vernier height gauge.

4. Perform accurate measurements using a variety of measuring instruments (internal, external, height).

MW1771 Basic Drawings

Learning Outcomes:

- Demonstrate knowledge of basic drawings and their applications.
- Demonstrate knowledge of interpreting and extracting information from drawings.
- Demonstrate knowledge of basic freehand sketches.
- Demonstrate knowledge of performing an accurate drawing from physical measurements.

Duration: 30 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with drawings.
   i. nominal size
   ii. limits
   iii. tolerance
   iv. allowance
   v. scale
   vi. symmetry

2. Identify types of basic drawings and sketches and describe their purpose.

3. Interpret and extract information from drawings.
   i. lines
   ii. projections
   iii. dimensions
   iv. views
   v. notes
   vi. finish symbols
   vii. lay symbols

4. Explain the principles of orthographic projection.

5. Describe basic sketching techniques.

6. Describe the procedures used to perform accurate reading and transfer of sizes.

7. Describe the procedures used to transfer information to the work piece.

Practical Requirements:

1. Demonstrate an accurate reading and transfer of sizes from physical measurements to create an accurate drawing.

2. Demonstrate the ability to read and interpret basic drawings and transfer information to the workpiece.

3. Prepare and dimension basic freehand sketches of mechanical components and assemblies.

4. Determine dimensions.

5. Identify tolerances and finishes.

MW1781 Cutting Fluids, Coolants, Lubricants and Solvents

Learning Outcomes:

- Demonstrate knowledge of cutting fluids, their applications, and procedures for use.
- Demonstrate knowledge of coolants, their applications, and procedures for use.
- Demonstrate knowledge of lubricants, their applications and procedures for use.
- Demonstrate knowledge of solvents, their applications, and procedures for use.

Duration: 15 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with fluids and coolants.

2. Identify hazards and describe safe work practices pertaining to fluids, and coolants.
   i. personal
   ii. shop/facility
   iii. environmental

3. Interpret codes and regulations pertaining to the use of fluids and coolants.

4. Identify types of fluids and coolants and describe their purpose, characteristics and applications.
   i. cutting fluids
   ii. coolants
   iii. lubricants
   iv. Solvents

5. Describe the types of friction and their implications.
   i. sliding friction
   ii. rolling friction
   iii. fluid friction

6. Describe the procedures used to handle, store and dispose of fluids and coolants.
   i. cutting fluids
   ii. coolants
   iii. lubricants
   iv. solvents

LUBRICANTS

7. Identify types of lubricants and describe their applications and procedures for use.
   i. hand oiler
   ii. wick feed
   iii. drip feed
   iv. slinger
   v. splash
   vi. pressure system
   vii. oil mist
   viii. grease nipples and cups

8. Describe the principles, purposes and importance of lubricants.

9. Describe handling, storage and disposal of lubricants.

10. Describe the types of lubricants and their associated methods of application.

11. Identify and interpret manufacturers' scheduling for selection of lubricants and lubrication times.

CUTTING FLUIDS AND COOLANTS

12. Identify coolants and describe their purpose and applications.

13. Describe the procedures used for mixing, maintaining, measuring and adjusting coolants.
   i. ratios
   ii. metric to imperial conversion

14. Describe the procedures used to apply cutting fluids and coolants.
    i. lathe work
    ii. drilling and reaming
    iii. milling
    iv. surface, cylindrical and internal grinding

SOLVENTS

15. Describe solvents, their characteristics and applications.

16. Describe procedures for safe use of solvents.

Practical Requirements:

1. Select and apply lubricants for machining operations.

2. Clean and lubricate instruments and machinery.

3. Identify, select and mix cutting fluids.

4. Identify, select, use and dispose of cleaning solvents

MW1791 Machinable Materials

Learning Outcomes:

- Demonstrate knowledge of metals and their characteristics.
- Demonstrate knowledge of machinable materials, their applications, and procedures for use.
- Demonstrate knowledge of specialty machineable materials.

Duration: 9 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with machinable materials.

2. Identify hazards and describe safe work practices pertaining to machining materials.

3. Describe the properties of metals and their characteristics.
   i. chemical
   ii. physical
   iii. mechanical

4. Describe the procedures used to determine the carbon content of metal.

5. Identify and interpret markings and documentation relating to material selection.
   i. identification systems
      - ASME
      - ANSI
      - colour coding (manufacturer specific)
      - number
   ii. documentation
      - mill certificates

6. Identify types of machinable materials and describe their characteristics and applications.
   i. metallic
      - ferrous
      - non-ferrous
   ii. non-metallic
   iii. specialty
      - alloys
      - refractory metals
      - precious metals

7. Identify types of coolants used with machinable materials and describe the considerations affecting their selection.

8. Explain the operating principles of machining materials.
   i. metallic
   ii. non-metallic
   iii. specialty

9. Describe the procedures used to set up and machine materials.

NON-METALLIC MATERIALS

10. Identify non-metallic materials and describe their characteristics and applications.

11. Describe hazards and safety precautions involved in machining non-metallic materials.

12. Describe the principles and procedures for machining non-metallic materials.

13. Describe the procedures used to mark work pieces for identification.

SPECIALTY STEELS

14. Identify ferrous metals and describe their characteristics and applications.

15. Describe hazards and safety precautions involved in machining special steels.

16. Identify coolants used with specialty steels and describe factors affecting their selection.

17. Identify non-ferrous metals and describe their characteristics and applications.

18. Explain the effects and purposes of alloying metal.

19. Describe the characteristics and applications of:
    i. white metals
    ii. refractory metals
    iii. precious metals

Practical Requirements:

1. Identify a variety of machinable materials.

MW1801 Precision Measurement II

Learning Outcomes:

- Demonstrate knowledge of gauge blocks, their applications and procedures for use.
- Demonstrate knowledge of angular measurement and its use.

Duration: 30 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Perform calculations for angular measurements using sine, cosine and tangents.

2. Identify types and grades of gauge blocks and describe their applications and procedures for use.
   i. metric
   ii. imperial
   iii. purpose
   iv. grades
   v. tolerance
   vi. accuracy
   vii. materials
   viii. set sizes and number of blocks

3. Identify pin and ball gauge sets.

4. Calculate and perform gauge block build-ups.

5. Identify height build-ups and describe their applications and procedures for use.
   i. calculations

6. Identify types of wear blocks and describe their purpose and applications.

7. Describe the factors that can affect gauge blocks and their impact.
   i. temperature
   ii. contaminants
   iii. maintenance
   iv. applications
   v. calculations

ANGULAR MEASUREMENT

8. Explain the principles of angular measurement.
   i. angle gauge blocks

9. Identify universal bevel protractors and describe their applications and procedures for use.
   i. parts
   ii. divisions
   iii. reading

10. Identify sine bars and describe their applications and procedures for use.

11. Identify compound sine plates and describe their applications and procedures for use.

12. Describe procedures used to maintain, store gauge and wring blocks.

Practical Requirements:

1. Perform gauge block build ups to check the accuracy of an angle using a dial indicator.

2. Demonstrate how to read a vernier protractor to perform angular measurement.

3. Perform calculations to achieve required angles using gauge blocks and a sine bar.

4. Perform measurement using angle gauge blocks.

MW2300 Power Sawing Equipment

Learning Outcomes:

- Demonstrate knowledge of power saws, their applications, maintenance and procedures for use.

Duration: 30 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with power saws.

2. Identify hazards and describe safe work practices pertaining to power saws.

3. Identify types of saws and attachments and describe their applications.
   - i. vertical
   - ii. horizontal
   - iii. reciprocating
   - iv. cold circular
   - v. abrasive cutoff
   - vi. hacksaw
   - vii. rip fence
   - viii. protective devices
   - ix. blade changes
   - x. saw guide selection
   - xi. power feed
   - xii. work holding devices

4. Identify types of sawing operations and describe their associated procedures.
   - i. contour
     - friction sawing
     - internal and external contour sawing
     - notching and slotting
     - radius cutting and splitting
   - ii. angular cutting
   - iii. stock cutting

iv. disc cutting
v. cut-off and mitering

5. Identify types of blades and describe their parameters, applications and installation procedures.
   i. composition
   ii. sizing
   iii. bandsaw length calculations
   iv. teeth
   v. pitch
   vi. set

6. Identify potential problems during sawing operations and describe their causes and remedies.

7. Calculate speed and feed requirements.
   i. factors
   ii. formulas
   iii. tables and charts

8. Describe preventive maintenance procedures for sawing equipment.
   i. care
   ii. storage
   iii. blade welding

9. Describe the procedures used to inspect and maintain power saws.

10. Describe the procedures used to set up and operate contour bandsaws.
    i. irregular shapes
    ii. internal/external contours

Practical Requirements:

1. Cut work accurately with below listed power saws
   i. vertical bandsaw.
   ii. horizontal bandsaw.
   iii. portable bandsaw.
   iv. abrasive cutoff saw.

2. Select and install bandsaw blades.

3. Adjust work rests and guards.

4. Weld band saw blade to calculated length.

MW2310 Introduction to Grinding and Abrasives

Learning Outcomes:

- Demonstrate knowledge of off hand grinding machines, their applications, and procedures for use.

Duration: 15 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with off hand grinding machines.

2. Identify hazards and describe safe work practices pertaining to off hand grinding machines.

3. Identify types of grinding machines and describe their applications.
   i. pedestal
   ii. surface
   iii. cylindrical
   iv. centreless
   v. tool and cutter grinder
   vi. die grinders
   vii. angle grinders

4. Describe the procedures used to perform offhand (bench) grinding operations.

5. Describe the procedures used to perform tool grinding operations on a carbide tool grinder.

6. Describe grinding wheels, their characteristics and applications.
   i. wire wheels and buffers
   ii. grinding disks
   iii. sanding disks
   iv. flap wheels
   v. rotary burrs
   vi. mounted points

vi. loose abrasives
vii. abrasives

7. Describe safety procedures and operating precautions related to grinding.
   i. speed
   ii. rests and guards
   iii. ring testing
   iv. machine condition
   v. dressing of wheels
   vi. wheel blotters

8. Describe types of hand dressers, their characteristics applications and procedures for use.
   i. abrasive stick
   ii. mechanical dressers (starwheel)

9. Describe the procedures used to test and mount a grinding wheel.

10. Describe the procedures used to dress a grinding wheel by hand.

11. Identify silicon carbide and aluminum oxide abrasives.

12. Describe the application of silicon carbide and aluminum oxide abrasives.

Practical Requirements:

1. Select various types of:
   i. grinding wheels
   ii. grinding wheel dressers

2. Perform hand grinding operations using steel stock.

3. Test and replace the grinding wheel.

4. Adjust work rests and guards.

5. Ring test, mount grinding wheel, set guards and dress wheel

MW2370 Material Testing

Learning Outcomes:

- Demonstrate knowledge of basic material testing and its applications.
- Demonstrate knowledge of material testing procedures.

Duration: 15 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with material testing.

2. Identify hazards and describe safe work practices pertaining to material testing.

3. Describe the purpose and applications of material testing.
   i. hardness
   ii. composition
   iii. properties

4. Identify types of tests performed on materials and describe their applications.
   i. destructive
      - tensile strength
      - impact
   ii. non-destructive
      - x-ray
      - dye penetrant/liquid penetrant
      - magnetic particle
   iii. spark
   iv. file

5. Identify the machines and scales used to determine material hardness and describe their associated procedures.
   i. Rockwell
   ii. Brinell
   iii. Scleroscope

6. Describe the procedures used to test steels.
   i. tensile strength test
   ii. impact test
   iii. spark test
   iv. file test

Practical Requirements:

1. Perform file and spark test.

2. Perform the procedure for testing metals.

MW2320 Heat Treatment

Learning Outcomes:

- Demonstrate knowledge of basic heat treatment and its applications.

Duration: 15 Hours

Pre-requisite(s): MW1190, MW2340

Objectives and Content:

1. Define terminology associated with heat treatment.

2. Identify hazards and describe safe work practices pertaining to heat treatment.

3. Identify methods used to determine the carbon content of steels.

4. Describe the procedures used to determine properties of metals.
   i. chemical
   ii. physical
   iii. mechanical

5. Identify the processes used in the heat treatment of metals and describe their applications.
   i. annealing
   ii. hardening
   iii. normalizing
   iv. stress relieving
   v. tempering
   vi. quenching
   vii. cooling
   viii. spheroidizing
   ix. forging

6. Identify and interpret technical data used in the heat treatment of metals.
   i. charts
   ii. tables

7. Describe the factors affecting the selection of tool steels.

8. Identify methods used for hardening steel and describe the properties of the steel produced by each.
   i. water hardening
   ii. oil hardening
   iii. air hardening
   iv. case hardening

9. Identify methods used to heat treat metals and describe their associated procedures and equipment.
   i. flame
   ii. furnace/oven
   iii. induction

Practical Requirements:

1. Heat treat a workpiece.

2. Perform hardness test for metals.

MW1841 Hoisting, Lifting and Rigging

Learning Outcomes:

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

Duration: 15 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with hoisting, lifting and rigging.

2. Describe responsibilities and liabilities in the use of rigging, lifting and hoisting equipment.

3. Identify hazards and describe safe work practices pertaining to hoisting, lifting and rigging.

4. Identify codes and regulations pertaining to rigging, hoisting and lifting.
   i. training and certification requirements

5. Identify types of rigging equipment and accessories and describe their applications, limitations and procedures for use.
   i. ropes
   ii. slings
   iii. chains
   iv. hooks
   v. spreader bars
   vi. shackles

6. Identify and interpret basic hand signals used for hoisting and lifting.

7. Identify types of hoisting and lifting equipment and accessories and describe their applications, limitations and procedures for use.

8. Identify types of knots, hitches, splices and bends and describe their applications and the procedures used to tie them.

9. Explain angle considerations when using rigging.
   i. rigging charts
   ii. rule of thumb formula
   iii. compensation for angles in lifting of loads

10. Describe the considerations when rigging material/equipment for lifting.
   i. load characteristics
   ii. equipment and accessories
   iii. environmental factors
   iv. anchor points
   v. sling angles

11. Describe the procedures used to inspect, maintain and store hoisting, lifting and rigging equipment.

Practical Requirements:

1. Select equipment and perform rigging procedures for safe lifting of loads.

2. Perform hand signals.

3. Tie knots, hitches and bends for a tagline.

MW1851 Drills and Drill Presses

Learning Outcomes:

- Demonstrate knowledge of drills and drill presses, their applications, maintenance and procedures for use.

Duration: 45 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with drills and drill presses.

2. Identify hazards and describe safe work practices pertaining to drills and drill presses.

3. Identify types of drill cutting tools and describe their applications.
   i. drills
   ii. counterbores
   iii. countersinks
   iv. machine taps
   v. machine reamers
   vi. spot facing tools
   vii. center drills

4. Describe a drill press, its parts and applications.
   i. base
   ii. column
   iii. table
   iv. drilling head

5. Identify types of drill presses and describe their components and applications.
   i. sensitive
      - motor driven
   ii. upright
      - parts
        - gear box

- spindle advance
- table

- operating principles
- capabilities

iii. radial arm

- parts
  - base
  - column
  - radial arm
  - drilling head
- operating principles
- capabilities
- magnetic
- safety precautions when working with a magnetic drilling machine

6. Identify drill press accessories and describe their applications and procedures for use.

i. jigs and fixtures

ii. work holding devices

- vises
- angle vise
- v-block
- step blocks
- angle plate
- drill jigs
- clamps
- jacks
- spacer blocks
- parallels

iii. tool holding devices

- drill chucks (tapered and threaded)
- key type
- keyless
- drill sleeves
- drill socket
- quick change
- power tapping attachment
- drifts

7. Identify types of machine reamers and describe their use.
   i. rose
   ii. fluted
   iii. carbide tipped
   iv. shell

8. Describe the procedures used to set up and perform drill press operations.
   i. drilling
   ii. counterboring
   iii. countersinking
   iv. tapping
   v. reaming
   vi. spot facing
   vii. center drilling

9. Identify materials used to manufacture drills and their application.
   i. high speed steel
   ii. cobalt
   iii. carbide
   iv. coated

10. Describe the methods of drill sizing.
   i. fractional size
   ii. number size
   iii. letter size
   iv. metric drills
   v. use of a drill gauge
   vi. measurement

11. Describe the procedures used to inspect, maintain and store drilling equipment and accessories.

12. Describe the procedures used to sharpen drill bits.

TWIST DRILLS

13. Identify twist drills and describe their characteristics and applications.
   i. Materials
   ii. sizing
   iii. components

- shank (tapered and straight)
- body (flutes, margin, body clearance, web)
- point (chisel edge, lips, lip clearance, heel, angles, variation, clearances)

14. Describe types of drills and their applications.
    i. high helix
    ii. core drills
    iii. oil hole drills
    iv. straight-fluted drills
    v. deep hole, gun and ejector drills
    vi. spade drills
    vii. hole-saws
    viii. centre drills
    ix. jobber drills

15. Describe potential problems during drilling operations, their causes, prevention and remedies.
    i. discoloration
    ii. broken or split drill
    iii. poor tool life
    iv. holes out of round
    v. color and chip shape
    vi. drilling pressures
    vii. poor hole finish
    viii. chatter
    ix. squeaking and jamming

16. Describe the procedures used to sharpen a twist drill.
    i. using offhand grinders
    ii. using drill sharpening machine
    iii. using a bench grinder
    iv. measuring angles for different materials
    v. point angle measurement
    vi. web thinning

SPEEDS AND FEEDS

17. Describe the considerations to determine speed, feed and depth of cut for drill press operations.

18. Perform calculations for speed, feed and depth of cut in metric and imperial units.
    i. materials
    ii. tool geometry
    iii. tool material
    iv. machine setup/rigidity

19. Interpret drill charts and tables.

20. Describe the procedures for performing spot facing, counterboring, countersinking and tapping operations.

21. Identify types of reamers and describe their applications.

22. Describe the procedures used for reaming holes.

23. Describe the sequence for drilling operations.

24. Perform calculations for tap drill sizing

Practical Requirements:

1. Sharpen a twist drill with correct clearance angles to suit various materials using freehand method and a drill sharpening machine.

2. Select, install and correctly use drills and accessories.

3. Drill and size holes accurately.

4. Perform spotfacing, counterboring and countersinking operations.

5. Ream straight holes.

6. Drill work held in a vise.

7. Drill large holes and deep holes.

8. Drill round work held in a v-block.

9. Tap holes by hand, by drill press and tapping attachment.

10. Use a Magnetic Drill Press in a vertical Position.

MW1861 Introduction to Conventional Lathes

Learning Outcomes:

- Demonstrate knowledge of conventional lathes, their accessories, attachments and applications.
- Demonstrate knowledge of lathe tools and their applications.

Duration: 45 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with conventional lathes.

2. Describe safety procedures and precautions related to lathe operation.
   i. safety glasses
   ii. clothing and jewelry
   iii. safety guards and lockout controls
   iv. secure work and tool mounting
   v. chuck wrench removal
   vi. use of air hoses

3. Identify types of conventional lathes and describe their operating principles and applications.
   i. engine lathe
   ii. single and multi-spindle automatic lathes

4. Identify the five major components of conventional lathes.
   i. head stock
   ii. tail stock
   iii. bed
   iv. carriage
   v. quick change gearbox

5. Identify the controls contained on the five major components of conventional lathes.

6. Identify conventional lathe accessories and attachments and describe their applications.

7. Identify types of tool holding devices and describe their applications.
   i. toolposts and tool holders
      - left hand offset
      - right hand offset
      - straight turning
      - parting tool
      - threading tool
      - boring bar
      - knurling tool
   ii. turret toolpost
   iii. quick change toolpost
   iv. face plate

8. Identify types of work holding devices and describe their applications.
   i. lathe centres
      - dead
      - live
      - micro-set
      - adjustable
   ii. chucks
      - three jaw universal
      - four jaw independent
      - spring collett
      - drill chuck
      - magnetic chuck
   iii. lathe dogs
      - standard bent-tail
      - straight tail
      - clamp type
   iv. mandrels
      - solid, expansion
      - gang
      - threaded
      - taper shank

9. Identify types of conventional lathe tools and describe their characteristics and applications.
   i. turning
   ii. boring
   iii. threading
   iv. grooving
   v. facing
   vi. knurling
   vii. part off

10. Describe procedures used for preventative maintenance of lathe machines.
   i. cleaning
   ii. lubrication
   iii. adjustments
      - gibs
      - tailstock
      - drive belts

11. Identify types of spindle noses and describe the operating principles.

12. Describe the procedures used to mount and remove chucks.

13. Describe the procedures used to assemble a three-jaw chuck.

14. Describe the factors used to determine speed, feed and depth of cut.
   i. calculations
   ii. charts and tables
   iii. material hardness
   iv. tool material
   v. machine condition
   vi. finish required
   vii. coolants and cutting fluids

CUTTING TOOLS

15. Describe tooling.
   i. types
   ii. composition
   iii. applications

16. Explain tool nomenclature.
    i. cutting edge
    ii. face
    iii. flank nose
    iv. radius
    v. point
    vi. shank

17. Describe the procedures used to sharpen conventional lathe cutting tools.

18. Describe the procedures used to grind cutting tool angles.

19. Describe angles and clearances.
    i. cutting tools
    ii. side cutting edge
    iii. end cutting edge
    iv. side relief (clearance angle)
    v. back rake (top)
    vi. side rake angle point angle

20. Describe the effects of tool characteristics and the importance of tool shape for lathe operations.
    i. roughing and finishing
    ii. facing
    iii. parting and grooving
    iv. threading tools
    v. round nose, forming and boring tools

21. Describe the procedures used to install tooling.

22. Describe the procedures used to face internal and external shapes and surfaces.

23. Describe the procedures used to set up and grind a tool bit.

Practical Requirements:

1. Grind a left hand turning and facing tool.

2. Grind a right hand turning and facing tool.

3. Grind a 60 degree threading tool.

4. Grind a parting off or grooving tool.

5. Clean and maintain the parts of a lathe and state their function.

6. Perform adjustments for gibs and backlash in the crosslide and compound rest.

MW1871 Basic Conventional Lathe Operation

Learning Outcomes:

- Demonstrate knowledge of conventional lathes, maintenance and procedures for use.

Duration: 60 Hours

Pre-requisite(s): MW1190, MW1861

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to conventional lathes.

2. Describe safety procedures and precautions related to filing and polishing.

3. Describe sequencing of lathe activities.

4. Describe the considerations to determine speed, feed and depth of cut for conventional lathe operations.

5. Calculate speed, feed and depth of cut.

6. Identify potential set up problems and describe their causes and remedies.

7. Describe the procedures used to set up lathes.

8. Describe the procedures used to mount and adjust rests.

9. Identify cutting fluids and coolants used during lathe operations.

10. Identify the considerations and requirements for selecting tools and accessories for specific operations.
    i. tool selection
    ii. set tool height

11. Describe the procedures used to operate, adjust and maintain conventional lathes.

12. Describe the procedures used to align lathe centres.

13. Describe the procedures used to perform basic conventional lathe operations.
    i. boring
    ii. threading
    iii. grooving
    iv. facing
    v. reaming
    vi. shoulders
    vii. parallel turning
    viii. shoulder turning
    ix. undercutting diameter and shoulders
    x. chamfering
    xi. radius
    xii. machining between centres
    xiii. knurling
    xiv. parting off
    xv. grooving
    xvi. trepanning

MACHINING IN A CHUCK

14. Describe the procedures used to mount work in a three-jaw chuck.

15. Describe the procedure used to mount work in a four-jaw chuck.

16. Describe the procedures used to set up in a four-jaw chuck using a dial indicator.

17. Describe factors that affect selection of tooling and accessories.

18. Describe the procedures used to cut or part off work in a chuck.

19. Describe the procedures used to set up and operate the lathe.

20. Describe the procedures used to produce rough and finished precision machined work in a chuck.

21. Identify techniques used to troubleshoot conventional lathe operations and describe their associated procedures.

22. Describe the procedures used to inspect and maintain conventional lathes.

Practical Requirements:

1. Mounting and remove chucks.

2. Assemble a three-jaw chuck.

3. Mount work in a three-jaw chuck.

4. Set up in a four-jaw chuck using a dial indicator.

5. Part off work in a chuck.

6. Perform the procedures for rough and finished turning work in a chuck.

7. Perform the procedures to set up a lathe to machine grooves.

8. Select tooling and accessories.

9. Set up and operate a lathe to:
   - i. machine grooves
   - ii. part off work pieces
   - iii. machine between centres
   - iv. knurl
   - v. radius
   - vi. machine diameters to size
   - vii. face to length
   - viii. machine to a shoulder
   - ix. parallel turn

MW1881 Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading

Learning Outcomes:

- Demonstrate knowledge of conventional lathe drilling, boring, reaming, tapping and die threading operations.

Duration: 30 Hours

Pre-requisite(s): MW1190, MW1871

Objectives and Content:

1. Describe the procedures used for spotting and drilling work on a conventional lathe.

2. Identify types of boring tools and describe their applications and procedures for use.

3. Describe the procedures used for boring work on a conventional lathe.

4. Identify hand reamers and describe their applications and procedures for use.

5. Identify types of machine reamers and describe their applications and procedures for use
   i. rose
   ii. fluted
   iii. carbide tipped
   iv. shell

6. Describe the procedures used for reaming work on a conventional lathe.
   i. reaming allowance
   ii. speeds
   iii. feed rates

7. Identify types of machine taps and dies and describe their applications and procedures for use.

8. Describe the procedures used for tapping on a conventional lathe.

9. Describe the procedures used to perform tapping operations.

10. Describe the procedures used for die threading on a conventional lathe.

11. Describe the procedures used for counterboring and countersinking work on a conventional lathe.

12. Describe speed, feed and depth of cut for conventional lathe operations.
    i. reaming
    ii. drilling
    iii. tapping
    iv. die threading
    v. counterboring
    vi. countersinking

13. Identify and describe mandrels their applications and procedures for use.

Practical Requirements:

1. Bore work held in a chuck.

2. Ream work in a lathe.

3. Perform tapping operations on a lathe.

4. Machine outside diameter by holding work on a mandrel.

MW1900 Taper Turning

Learning Outcomes:

- Demonstrate knowledge of tapers, their attachments and applications.
- Demonstrate knowledge of taper turning operations.

Duration: 30 Hours

Pre-requisite(s): MW1190, MW1881

Objectives and Content:

1. Define terminology associated with taper turning.

2. Identify hazards and describe safe work practices pertaining to taper turning.

3. Identify types of tapers and describe their applications.
   i. self-holding tapers
   ii. steep tapers
   iii. standard tapers

4. Identify types of taper attachments and describe their applications and procedures for use.
   i. plain
   ii. telescopic
   iii. compound rest

5. Calculate dimensions of tapers in metric and imperial.

6. Describe the formula for taper calculations.
   i. taper per foot
   ii. taper per inch
   iii. metric tapers

7. Perform angular measurements.

8. Calculate tailstock offset.

9. Identify methods used to turn tapers and describe their associated procedures.
   i. taper attachment
   ii. tailstock
   iii. compound rest

10. Identify methods used to check tapers and describe their associated procedures.
   i. plug gauge
   ii. ring gauge
   iii. sine bar
   iv. layout lines

11. Describe the procedures used to calculate and perform taper advancement.

12. Describe the procedures used to measure tapers.
   i. metric
   ii. imperial

13. Describe the procedures used to fit an external taper.

Practical Requirements:

1. Turn various tapers (internally and externally)
   i. compound rest.
   ii. tailstock offset.
   iii. taper attachment.

2. Measure taper using available method.
   i. sinebar.
   ii. three lines.
   iii. chaulk or Prussian blue.

MW1911 Basic Threading

Learning Outcomes:

- Demonstrate knowledge of setting up lathes to machine threads.
- Demonstrate knowledge of measure and gauge threads.
- Demonstrate knowledge of cutting internal and external threads according to classification.

Duration: 60 Hours

Pre-requisite(s): MW1190, MW1881

Objectives and Content:

THREAD CHARACTERISTICS

1. Describe threads and their applications.

2. Explain thread parts and terminology.
   - i. screw thread
   - ii. internal and external threads
   - iii. major and minor diameter
   - iv. pitch diameter
   - v. number of threads
   - vi. pitch
   - vii. lead
   - viii. root
   - ix. crest
   - x. flank
   - xi. depth of thread
   - xii. angle of thread
   - xiii. helix or lead angle
   - xiv. right and left hand threads

3. Identify thread forms and describe their characteristics.
   i. ISO metric
   ii. unified
   iii. ACME
   iv. National Pipe thread
   v. British Standard Whitworth
   vi. British Standard Fine
   vii. square and modified square
   viii. International Metric
   ix. buttress

4. Explain thread fit terms, classifications and symbols used for imperial and metric threads.
   i. fit allowance
   ii. tolerance
   iii. limits
   iv. nominal and actual size
   v. tolerance grades
   vi. allowance symbols and numbers

5. Identify thread formula that apply to thread forms and parts of a thread.
   i. 60 degree V thread
   ii. American National
   iii. Unified
   iv. Metric
   v. minor diameter
   vi. crest width
   vii. number thread size
   viii. tap drill size
   ix. pitch of the thread
   x. pitch diameter
   xi. root width
   xii. lead
   xiii. depth

6. Describe the procedures used to transpose lathe gears for threading.

THREAD CUTTING OPERATIONS

7. Describe the procedures used to sharpen tools and set up a lathe accurately for threading.

8. Identify the thread chasing dial and describe its applications and procedures for use.

9. Describe procedures used to reset a threading tool.

10. Describe the various methods used to measure and gauge threads.
    i. thread ring gauges
    ii. thread plug gauges
    iii. snap gauges
    iv. three wire method
    v. thread micrometer
    vi. thread comparator micrometer

Practical Requirements:

1. Machine threads:
    i. national course
    ii. national fine
    iii. right hand external
    iv. right hand internal
    v. left hand external
    vi. left hand internal

2. Machine a metric thread

3. Perform measurement of threads using the three wire method.

4. Measure thread using alternative methods.

5. Repair damaged thread by picking up a thread.

MW1921 Introduction to Milling Machines

Learning Outcomes:

- Demonstrate knowledge of milling machines, their accessories, attachments and applications.
- Demonstrate knowledge of milling cutting tools and their applications.

Duration: 72 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with milling machines.

2. Identify hazards and describe safe work practices pertaining to conventional milling machines.

3. Identify types of milling machines and describe their applications.
   i. vertical
   ii. horizontal/universal
   iii. ram and turret
   iv. horizontal boring mill
   v. plain horizontal
   vi. standard vertical
   vii. manufacturing types
   viii. numerically controlled machine centres

4. Identify the components and controls of milling machines and describe their purpose and operation.
   i. base
   ii. table
   iii. housing
   iv. overarm and arbor supports
   v. knee
   vi. column
   vii. saddle
   viii. speed and feed controls

ix. hand wheels, cranks and graduated collars
x. coolant system
xi. backlash eliminator
xii. table swivel block
xiii. feed trip dogs and limit stops
xiv. parts and controls specific to vertical mills
xv. elevating mechanism
xvi. drive
xvii. overarm (ram)
xviii. draw bolts
xix. digital readout

5. Identify types of milling machine accessories and attachments and describe their applications and maintenance.
   i. fixture
   ii. arbors, collets and adaptor
   iii. vises
   iv. dividing head
   v. backlash eliminator
   vi. clamps
   vii. t-nuts
   viii. slotting attachment
   ix. vertical attachment
   x. edge finder/centre finder
   xi. offset boring head

6. Identify types of tool holding devices and describe their applications.

7. Identify types of work holding devices and describe their applications and maintenance.

8. Identify types of materials used in milling cutter construction and describe their characteristics.
   i. high speed steel
   ii. tungsten carbide
   iii. titanium
   iv. cemented carbides
   v. ceramic

9. Identify types of cutting tools and describe their applications.
   i. plain milling cutters
   ii. standard shank-type helical milling cutters
   iii. side milling cutters
   iv. face milling cutters
   v. angular cutters
   vi. formed cutters
   vii. metal saws
   viii. end mills
   ix. t-slot cutters
   x. dovetail cutter
   xi. woodruff keyseat cutter
   xii. flycutters

10. Identify milling cutter failures and describe their causes and remedies.

11. Describe climb and conventional milling.

MILLING MACHINE SETUP

12. Describe the factors that determine milling feed, speed and depth of cut calculations and their importance.

13. Describe the procedures used to perform calculations for milling feed and depth of cut for metric and imperial milling operations.

14. Describe the two types of feed directions, their differences and applications.

15. Describe safety practices relating to milling machines.

16. Describe the set up procedures for mounting and removing milling cutters.

17. Describe the procedures used to align a vise on a milling machine.

18. Identify appropriate cutters, work holding devices and accessories for applications.

19. Describe procedures used to align vertical milling machine head.

20. Describe procedures used to locate an edge.

21. Describe the procedures used to maintain and adjust mills.

22. Describe the procedures used to clean and lubricate milling machines.

23. Describe potential set-up problems, their causes and remedies.

24. Describe the procedures used to set up and cut opposing keyways in a shaft.

25. Describe the rectangular coordinates system.

26. Describe procedures to perform, basic indexing.

Practical Requirements:

1. Align a vise on a milling machine set up and remove attachments.

2. Set up indexing head and foot stock.

3. Machine keyseats.
   i. woodruff
   ii. square

4. Drill bolt circle using digital readout.

MW1951 Reciprocating Machines

Learning Outcomes:

- Demonstrate knowledge of slotters and shapers, their applications, set up and procedures for use.
- Demonstrate knowledge of broaching and keyseating machines, their applications, set up and procedures for use.

Duration: 45 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with reciprocating machines.

2. Identify hazards and describe safe work practices pertaining to reciprocating machines.

3. Identify types of slotters and shapers and describe their components and applications.

4. Calculate speed and feed requirements.

SHAPERS

5. Identify shapers and describe their characteristics and applications.
   i. parts
   ii. capacity

6. Describe the procedures used for setting up shapers.
   i. stroke length
   ii. stroke positioning
   iii. work piece alignment
   iv. ram positioning

7. Describe the procedures used to grind a shaper cutting tool.

SLOTTERS

8. Describe the procedures used to set up and operate slotters.
   i. stroke length
   ii. stroke angle
   iii. stroke positioning
   iv. workpiece alignment

9. Identify slotters and describe their characteristics and applications.
   Parts
   i. capacity
   ii. applications

10. Describe the tool holders and cutters used with slotters.

11. Identify work holding devices used with slotters and describe their characteristics and applications.

MACHINE BROACHING

12. Explain the operating principles of machine broaching and keyseating.

13. Identify types of broaching and keyseating machines and describe their components and-applications.

14. Identify types of tooling for broaching and keyseating machines and describe their applications.

15. Describe the procedures used to set up and operate broaching and keyseating machines.

16. Describe the procedures used for broaching slots.

17. Describe the procedures for cutting keyways.

Practical Requirements:

1. Perform speed, feed and depth calculations.

3. Set stroke length and ram positioning.

3. Machine a part using a shaper.

4. Cut a keyway using a slotter.

MW1961 Machine Cutting Tools

Learning Outcomes:

- Demonstrate knowledge of cutting machine tools, their applications and procedures for use.
- Demonstrate knowledge of cutting tool geometry and its use.

Duration: 15 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with cutting machine tools.

2. Identify hazards and describe safe work practices pertaining to cutting machine tools.

3. Explain the principles of chip formation.

4. Identify types of cutting machine tools and describe their characteristics and applications.
   i. indexible insert
   ii. high speed steel (HSS)
   iii. braised carbide

5. Identify types of cutting tool materials and describe their applications and procedures for use.
   i. carbide
   ii. high speed steel (HSS)
   iii. ceramic
   iv. diamond

6. Explain tool geometry and its purpose.
   i. front or end relief (clearance)
   ii. side relief (clearance) side cutting edge angle
   iii. nose radius
   iv. side rake
   v. back rake
   vi. negative/positive carbide insert geometry

7. Describe the procedures used to sharpen cutting tools.

8. Interpret the ANSI and SI systems for the identification of carbide inserts/coatings and tool holders.

9. Describe the effect of carbide cutting tools on speed, feed and depth of cut.

10. Identify types of carbide tool holding devices and describe their applications.

11. Identify carbide tool failures and describe their causes and remedies.

Practical Requirements:

1. Calculate speeds and feeds and depth of cut.

2. Grind carbide tooling.

3. Use carbide tooling.

MW2061 Computer Numerical Control (CNC) Machine-Tools

Learning Outcomes:

- Demonstrate knowledge of CNC machine-tools, their accessories, attachments and applications.

Duration: 15 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with CNC machine-tools.

2. Identify the hazards and describe safe work practices pertaining to CNC machines-tools.

3. Describe the advantages of using CNC machine-tools.
   i. machine tool movement
   ii. accuracy
   iii. reliability
   iv. repeatability
   v. productivity

4. Identify CNC axes and describe the relationship between them.

5. Identify types of CNC machine-tools and describe their characteristics and applications.
   i. type
   ii. size
   iii. turning centre
   iv. combination
   v. vertical
   vi. horizontal

6. Identify types of accessories and tool changers used with CNC machine-tools and describe their applications.
   i. tool changers
   ii. accessories
   iii. tool holders
   iv. work holding devices

7. Identify types of tool holders and work holding devices used with CNC machine-tools and describe their applications.

Practical Requirements:

No Practical

MW2071 Computer Numerical Control (CNC) Operation 1

Learning Outcomes:

- Demonstrate knowledge of basic CNC programming.
- Demonstrate knowledge of CNC machine-tools, their set up, maintenance and procedures for use.

Duration: 45 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Identify CNC control units and describe their purpose.

2. Identify types of basic programming codes and languages and describe their applications.
   i. G-codes
   ii. M-codes
   iii. conversational

3. Identify CNC-related reference points and their location.

4. Describe the procedures used to perform basic CNC programming.
   i. review process documentation
   ii. calculate coordinates for tool path
   iii. create basic program
   iv. input program data into control memory
   v. optimize program

5. Describe the procedures used to set up CNC machines.
   i. send/receive program
   ii. select and set up tooling and tool holder
   iii. tool offsets
   iv. set up workpiece
   v. establish work datum
   vi. verify program

6. Describe the procedures used to operate CNC machines.
   i. adjust offsets
   ii. load/unload workpiece
   iii. monitor process
   iv. interupt program cycle
   v. restart program cycle

7. Describe the procedures used to perform basic preventative maintenance.

Practical Requirements:

1. Write a program to produce a simple part on the CNC Mill and Lathe.

2. Operate the CNC Mill and Lathe to produce the part.

MW2081 Mechanical Components

Learning Outcomes:

- Demonstrate knowledge of mechanical components, their applications and procedures for use.

Duration: 15 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Define terminology associated with mechanical components.

2. Identify hazards and describe safe work practices pertaining to mechanical components.

3. Identify types of fasteners, retainers and locators and describe their characteristics and applications.
   i. bonds (adhesives)
   ii. nuts
   iii. dowel pins
   iv. washers
   v. studs
   vi. snap rings
   vii. rivets
   viii. keys
   ix. splines
   x. screws
   xi. lock wires
   xii. bolts
   xiii. self-locking nuts

4. Identify head styles of threaded fasteners and describe their characteristics and applications.

5. Explain the term "fit" and the types of fits and their applications relating to hubs.
   i. clearance fits
   ii. transition fits
   iii. interference fits

6. Identify techniques used to torque fasteners and describe their associated procedures.

7. Identify nut and bolt designs and describe their characteristics and applications.

8. Identify grades of nuts and bolts and describe their characteristics and applications.

9. Identify types of keys, keyseats and keyways and describe their characteristics and applications.
   i. square
   ii. woodruff
   iii. flat
   iv. gib

10. Explain the principles of stepped keys.

11. Describe the procedures used to hand broach keyways.

12. Identify broaches and describe their characteristics and applications.

13. Describe the procedures used to perform hand broaching.

14. Describe the procedures used for safe operation of an arbor press.

15. Identify types of bearings and bushings and describe their characteristics and applications.

16. Describe the procedures used to install tapered pins in hub and shaft assembly.

Practical Requirements:

1. Select the different types of fasteners.

2. Broach a keyway.

MW2121 Oxy Fuel Welding and Cutting

Learning Outcomes:

- Demonstrate knowledge of the set up and use oxy fuel welding equipment.

Duration: 30 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Describe hazards and safe practices associated with oxy fuel welding equipment.
   i. welding screens
   ii. ventilation (local exhausts)
   iii. freely movable hood
   iv. fixed enclosure
   v. down draft benches
   vi. confined spaces

2. Identify codes, regulations, training and certification requirements pertaining to oxy fuel welding.

3. Describe the use of PPE associated with arc welding.
   i. eye and face protection
   ii. safety goggles
   iii. welding shields
   iv. welding jackets
   v. gloves
   vi. aprons
   vii. respirators and dust masks
   viii. lense selection

4. Describe safe practices relating to the operation of oxygen and acetylene equipment.
   i. properties of oxygen, acetylene, and propane
   ii. handling and transporting cylinders
   iii. storage of cylinders
   iv. cylinder safety devices

- bursting discs
- fusible plugs
- release valves

v. cylinder pressures
vi. valve threads
vii. contamination of oil and grease
viii. flashback arrestor
ix. flash back and back fires

5. Describe procedures used to set-up and use welding equipment. (OFW)
   i. safety precautions
   ii. inspection of work area for possible hazards
   iii. equipment
   iv. set up
   v. adjustment
   vi. check for leaks
   vii. light-up procedure
   viii. flame adjustment
   ix. shut down procedures
   x. storage

6. Identify types of tips used in cutting and welding and describe their applications.
   i. numbering system for tips
   ii. styles of tips:
   - cutting
   - welding
   - heating tips

7. Describe the procedure to perform cutting using oxygen fuel equipment.

8. Describe the procedures used to perform brazing.

9. Describe the procedures used to perform silver soldering.

10. Describe the procedure to perform soft soldering.

Practical Requirements:

1. Set up and use oxy-fuel welding equipment
    i. cut mild steel freehand
    ii. perform silver soldering

MW2340 Reconditioning

Learning Outcomes:

- Demonstrate knowledge of the procedures used for reconditioning.

Duration: 15 Hours

Pre-requisite(s): MW1190

Objectives and Content:

1. Identify types of fits, clearances, tolerances, and serviceable limits.

2. Identify types of mechanical components and describe their disassembly procedures.
   i. bearings
   ii. seals
   iii. threaded inserts
   iv. adapters/bushings

3. Describe the procedures used to repair or replace mechanical components.

4. Identify types of equipment used in reconditioning and describe their procedures for use.
   i. pullers
   ii. presses
   iii. portable keyseat cutter

5. Identify types of materials used to fit and reassemble components and describe their applications and procedures for use.
   i. adhesives
   ii. sealants
   iii. lubricants and lubrication systems

6. Describe the procedures used to fit and reassemble components.

Practical Requirements:

1. Use portable keyseat cutter to machine a keyseat.

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.

AM1180 Industrial 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.

8. Identify the principles for writing clear, concise, complete sentences and paragraphs which adhere to the conventions of grammar, punctuation, and mechanics.

9. 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

10. 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

11. 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

12. 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

13. 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

MW1811 Advanced Drawings

Learning Outcomes:

- Demonstrate knowledge of views of drawings and their applications.
- Demonstrate knowledge of industry symbols and markings and their applications.
- Demonstrate knowledge of geometric dimensions and tolerances and their applications.

Duration: 30 Hours

Pre-requisite(s): Block I

Objectives and Content:

1. Identify drawing views and describe their purpose and applications.
   i. isometric
   ii. orthographic
   iii. sectional
   iv. auxiliary

2. Identify and interpret industry symbols and markings and describe their applications.
   i. surface textures
   ii. violations of true projections
   iii. auxiliary views
   iv. positional dimension
   v. hidden (phantom) lines
   vi. geometric dimensions and tolerances
   vii. datums
   viii. moldings, forgings and castings

3. Explain the principles of geometric dimensioning and tolerancing.

4. Identify types of sectional views and describe their characteristics and applications.

Practical Requirements:

1. Produce intermediate drawings and transfer information from a workpiece.

2. Determine tolerances and finish symbols.

3. Determine geometric features for a given workpiece.

MW2350 Precision Layout

Learning Outcomes:

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

Duration: 30 Hours

Pre-requisite(s): Block I

Objectives and Content:

1. Identify precision layout tools and equipment and describe their applications and procedures for use.
   i. universal bevel protractor
   ii. sine bar
   iii. precision height gauge
   iv. gauge blocks
   v. sine plate

2. Describe the procedures used to perform a precision layout using a sine bar, gauge blocks and a precision height gauge.

3. Calculate sine bar values.

4. Calculate angles, arcs and location from reference point.

5. Describe the procedures used to inspect, maintain and store precision layout tools and equipment.

6. Describe the basic terms of measurement.
   i. basic dimension
   ii. limits
   iii. tolerance (unilateral and bilateral)
   iv. allowance
   v. dual dimensioning

Practical Requirements:

1. Perform a precision layout from a drawing using a sine bar, gauge blocks and a precision height gauge.

2. Verify layout against drawings.

MW2360 Horizontal/Universal Milling Machine Operation

Learning Outcomes:

- Demonstrate knowledge of horizontal/universal milling machines, their set up, maintenance and procedures for use.

Duration: 45 Hours

Pre-requisite(s): Block I

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to horizontal/universal milling machines.

2. Describe the considerations used to determine speed, feed and depth of cut for horizontal/universal milling machine operations.

3. Calculate speed, feed and depth of cut.

4. Identify potential set up problems and describe their causes and remedies.

5. Describe the procedures used to align workpieces.

6. Describe the procedures used for setting the cutter to the work surface.

7. Describe the procedures used to set up horizontal/universal milling machines to perform basic milling operations.

8. Describe the two basic types of milling machine operations.
   i. plain milling
   ii. face milling

9. Identify the considerations and requirements for selecting tools and accessories for milling operations.

10. Describe the procedures used for milling a flat surface.
    i. rough/finish
    ii. positioning cutter

11. Describe the procedures used to maintain horizontal/universal milling machines.

12. Describe the procedures used for machining.
    i. angles
    ii. keyways
    iii. slots

13. Describe the procedures used to perform milling operations on horizontal/universal milling machines.
    i. surfacing
    ii. keyways and keyseats
    iii. conventional
    iv. flat surface
    v. face
    vi. side
    vii. straddle
    viii. gang
    ix. climb

14. Describe the procedures used with sawing and slitting cutters.

15. Identify milling cutter failures and describe their causes and remedies.

16. Identify techniques used to troubleshoot horizontal/universal milling operations and describe their associated procedures.

Practical Requirements:

1. Centre and set the cutter to the work surface.

2. Mill a flat surface.

3. Perform milling operations.
   i. face
   ii. side
   iii. straddle
4. Perform sawing/slitting operations.

5. Align the table on a universal milling machine.

MW1931 Advanced Conventional Lathe Operation

Learning Outcomes:

- Demonstrate knowledge of contours and forms.
- Demonstrate knowledge of advanced threading and multiple starts.

Duration: 105 Hours

Pre-requisite(s): Block I

Objectives and Content:

CONTOURS AND FORMS

1. Explain the principles of form turning.

2. Identify types of form turning tools and describe their characteristics and applications.

3. Describe the procedures used to turn forms.

4. Describe the procedures used to mount and adjust rests.

5. Describe the procedures used for toolpost grinding.

6. Describe the procedures used to set up, position work and turn eccentrics.

THREADS

7. Describe thread forms and classes of fit.

8. Describe the procedures used to perform imperial and metric thread calculations.

9 Describe the procedures used to change an imperial design lathe to metric threading.

10. Describe the procedures for cutting internal and external threads.

11. Describe the procedures used to cut threads on a tapered section.

12. Describe the procedures used to cut left hand thread.

13. Describe the instruments used to measure threads.

14. Describe the procedures used to measure threads.
    i. three-wire method
    ii. one-wire method
    iii. thread micrometer

ADVANCED THREADING AND MULTIPLE STARTS

15. Identify types of advanced threads and describe their purpose, characteristics and applications.
    i. specialty
        - ACME
        - buttress
        - tapered pipe
        - straight pipe
    ii. multiple start

16. Identify methods used to cut multiple start threads and describe their associated procedures.
    i. slotted drive or faceplate
    ii. indexing of the spindle gear
    iii. use of thread chasing dial
    iv. compound rest method

17. Identify methods used to cut specialty threads and describe their associated procedures.
    i. ACME
    ii. buttress
    iii. tapered pipe
        - straight pipe

18. Describe the procedures used to check and measure threads.

19. Describe the purpose of internal threads.

20. Describe the procedure used to cut a tapered thread

21 Describe the procedures used to set up eccentrics on conventional lathes.

22. Describe the procedures used to set up and perform line boring.

Practical Requirements:

1. Calculate and measure using the one wire method (ACME)

2. Machine a double start ACME stud.

3. Machine a mating nut with 2A and 2B fit for an ACME thread.

4. Perform calculations, set-up and work positioning to machine eccentrics.

5. Machine a tapered pipe thread.

6. Set up and machine a contour.

7. Perform line boring.

MW1941 Job Planning

Learning Outcomes:

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

Duration: 15 Hours

Pre-requisite(s): Block I

Objectives and Content:

1. Identify sources of information relevant to job planning.
   i. documentation
      - work orders/shop orders
      - technical data
      - reference materials
        - drawings
        - related professionals
        - clients
        - quality standards
      - International Standards Organization (ISO)

2. Interpret and complete relevant trade documentation.

3. Interpret advanced drawing specifications.
   i. tolerance
   ii. finish requirements
   iii. geometric dimensioning and tolerancing

4. Describe effective information gathering and communication techniques.
   i. questioning
   ii. translating technical information
   iii. using communication equipment

5. Identify operations to be performed in priority sequence.

6. Calculate cutting time requirements.

7. Identify the considerations and requirements for selecting machines and tooling to complete specified jobs.

8. Calculate materials required to complete specified jobs.

9. Identify and explain fixed and variable costs.

Practical Requirements:

1. Perform cutting time calculations.

2. Perform a cost estimate for a given job.

3. Make a simple part and monitor machining time.

MW1991 Quality Inspection

Learning Outcomes:

- Demonstrate knowledge of quality inspection and its use.
- Demonstrate knowledge of the Cartesian Coordinate System and its use.
- Demonstrate knowledge of coordinate measuring machines, their applications and procedures for use.

Duration: 15 Hours

Pre-requisite(s): Block I

Objectives and Content:

1. Define terminology associated with quality inspection.
   i. basic dimension
   ii. limits
   iii. tolerances
   iv. allowance
   v. geometric

2. Describe the purpose, parts and applications of the coordinate measuring system.

3. Identify types of precision gauges used in quality inspection and describe their applications and procedures for use.
   i. fixed
   ii. cylindrical
   iii. ring
   iv. taper
   v. snap
   vi. pin
   vii. ball
   viii. drill blank rods

4. Identify types of precision measuring instruments used in quality inspection and describe their applications and procedures for use.

5. Describe the procedures used to inspect workpieces.

6. Identify types of comparators and describe their applications and procedures for use.
   i. mechanical
   ii. electronic
   iii. optical
   iv. pneumatic
   v. dial indicators

7. Describe the Rectangular, Cartesian, Cylindrical and Polar Coordinate Systems, its purpose and applications.

8. Identify types of coordinate measuring machines and describe their components, applications and procedures for use.

9. Describe the instruments used to measure surface roughness.

10. Describe the instruments and procedure used to measure roundness.

11. Describe the instruments used to measure concentricity.

Practical Requirements:

1. Perform a quality assurance check on a part using appropriate equipment.

2. Perform runout and concentricity testing procedures.

3. Inspect surface finishes and interpret results.

4. Use a Coordinate Measuring Machine (CMM).

5. Use an Optical Measuring Machine.

6. Use Electronic Measuring equipment.

BLOCK III

MW1981 Gears and Gear Cutting

Learning Outcomes:

- Demonstrate knowledge of gears and gear cutting.
- Demonstrate knowledge of gear measurement.
- Demonstrate knowledge of gear milling operations.

Duration: 45 Hours

Pre-requisite(s): Block II

Objectives and Content:

1. Define terminology associated with gears and gear cutting.
   - i. addendum
   - ii. centre distance
   - iii. chordal addendum
   - iv. chordal thickness
   - v. circular thickness
   - vi. clearance
   - vii. circular pitch
   - viii. dedendum
   - ix. diametrical pitch
   - x. involute
   - xi. linear pitch
   - xii. module (metric gears)
   - xiii. outside diameter
   - xiv. pitch circle
   - xv. pitch circumference
   - xvi. pitch diameter
   - xvii. pressure angle
   - xviii. root circle
   - xix. root diameter
   - xx. tooth thickness
   - xxi. whole depth
   - xxii. working depth

2. Identify hazards and describe safe work practices pertaining to gears and gear cutting.

3. Explain the principles of gears and describe their purpose and operation.

4. Identify types of gears and describe their characteristics and applications.
   i. spur
   ii. helical
   iii. bevel
   iv. worm
   v. rack
   vi. internal
   vii. pinion
   viii. hypoid
   ix. herringbone
   x. miter
   xi. angular bevel
   xii. worm and worm gears

5. Describe the procedures used for rack milling.

GEAR TOOTH MEASUREMENT

6. Identify methods of gear tooth measurement and describe their associated procedures.
   i. micrometer and wire
   ii. gear tooth vernier

7. Describe the factors affecting accurate measurement of gear teeth.

GEAR CUTTING

8. Describe the characteristics of involute gear cutters.

9. Describe how gear cutters are sized.
   i. imperial
   ii. metric

10. Describe the characteristics of a gear cutter set and the factors relating to the number of gear teeth to be cut.

11. Identify and interpret the chart for involute gear cutters.
    i. metric
    ii. imperial

12. Describe the procedures used to cut a spur gear.

13. Calculate gear cutting requirements.

14. Calculate ratios for simple and compound gear trains.

15. Identify machines and accessories used to cut gears.

16. Identify types of gear cutting tools and describe their characteristics and applications.

17. Describe the procedures used to set up and produce gears using a horizontal mill.

18. Describe the procedures used to perform gear cutting operations on vertical milling machines.

19. Describe procedures used to cut a rack gear.

Practical Requirements:

1. Perform the calculations and procedures for cutting a spur gear.

2. Perform gear tooth measurement.

3. Perform differential indexing.

MW2000 Vertical Milling Machine Operation

Learning Outcomes:

- Demonstrate knowledge of vertical milling machines, their set up, maintenance and procedures for use.

Duration: 85 Hours

Pre-requisite(s): Block II

Objectives and Content:

1. Identify vertical milling machines and describe their construction and features.

2. Identify hazards and describe safe work practices pertaining to vertical milling machines.

3. Describe the considerations used to determine speed, feed and depth of cut for vertical milling machine operations.

4. Calculate speed, feed and depth of cut.

5. Identify potential set up problems and describe their causes and remedies.

6. Describe the procedures used to tram or align vertical milling machine heads.

7. Describe the procedures used to align workpieces.

8. Describe the procedures used to set up vertical milling machines to perform basic milling operations.

9. Identify the considerations and requirements used for selecting tools and accessories for milling operations.

10. Describe the procedures used to perform milling operations on vertical milling machines.
    i. contouring
    ii. angles and radii.
    iii. parallel T-slots.
    iv. pocketing
    v. boring
    vi. reaming
    vii. grooving
    viii. surfacing
    ix. tapping
    x. drilling
        - counterboring
        - chamfering
        - spotfacing
        - countersinking
    xi. dovetailing
        - parts
        - calculations
        - measurements
        - procedures

11. Describe the procedures used to mill profiles and pockets using vertical milling machines.

12. Describe the procedures used to inspect and maintain vertical milling machines.

13. Identify types of rotary tables and describe their construction, applications and procedures for use.

14. Describe the procedures used to perform milling operations using rotary tables.
    i. machine slots with a dividing head
    ii. mill surfaces
    iii. shapes
    iv. mill using indexing heads
    v. machine angles and radii

15. Identify types of dividing heads and describe their characteristics and applications.
    i. standard
    ii. wide range

16. Explain the principles and perform calculations involved in indexing.
    i. direct
    ii. simple
    iii. angular
    iv. differential
    v. linear division

17. Identify milling cutter failures and describe their causes and remedies.

18. Identify techniques used to troubleshoot vertical milling operations and describe their associated procedures.

Practical Requirements:

1. Perform the calculations required to mill a cam.

2. Layout a bolt hole pattern on a rotary table.

3. Machine an internal and external dovetail.

4. Machine a T-slot.

MW2010 Boring Mills

Learning Outcomes:

- Demonstrate knowledge of setting up and operating boring mills.

Duration: 5 Hours

Pre-requisite(s): Block II

Objectives and Content:

BORING MILLS

1. Identify boring mills and describe their components and applications.
   i. horizontal
   ii. vertical

2. Identify types of tooling and accessories for boring mills and describe their applications.

3. Describe the procedures for the set-up of horizontal and vertical boring mills.

4. Describe the procedures used to calculate for speeds and feeds.

5. Describe the procedures used for boring holes.

6. Describe the procedures used to perform facing operations.

Practical Requirements:

No Practical

MW2021 Abrasive Finishing

Learning Outcomes:

- Demonstrate knowledge of abrasives, their applications and procedures for use.
- Demonstrate knowledge of grinding wheels, their applications, maintenance and procedures for use.
- Demonstrate knowledge of abrasive finishing techniques.

Duration: 10 Hours

Pre-requisite(s): Block II

Objectives and Content:

1. Define terminology associated with abrasive finishing.

2. Identify hazards and describe safe work practices pertaining to abrasives.

3. Identify types of abrasives and describe their characteristics and applications.
   i. aluminum oxide
   ii. silicon carbide
   iii. zirconia-aluminum oxide
   iv. boron carbide
   v. ceramic aluminum oxide
   vi. diamond
   vii. cubic boron nitrate
   viii. coated
   ix. lapping
   x. loose
   xi. compound

4. Identify types of grinding wheels and describe their characteristics and applications.

5. Identify the considerations and requirements for selecting a grinding wheel for common grinding operations.
   i. abrasive
   ii. grain
   iii. grade
   iv. structure
   v. bond
   vi. application
   vii. shapes

6. Locate and interpret grinding wheel codes.

7. Describe the procedures used to mount and balance grinding wheels.

8. Identify types of wheel dressers and describe their applications.

9. Describe the procedures used to true and dress grinding wheels.

10. Describe the procedures used to inspect, maintain and store grinding wheels.

11. Identify coated abrasives and describe their characteristics, construction and applications.

12. Describe the types of manufactured diamond and their characteristics.

13. Describe the procedures used to shape or finish a workpiece using abrasive techniques.

14. Identify types of materials and equipment used to lap and hone workpieces.

15. Identify lapping and honing techniques and describe their associated procedures.

16. Identify types of materials and equipment used to buff and polish workpieces.

17. Identify polishing and blending techniques and describe their associated procedures.

Practical Requirements:

1. Select a grinding wheel for a specified material then ring test, mount, and balance.

MW2031 Cylindrical Grinders

Learning Outcomes:

- Demonstrate knowledge of cylindrical grinders, their set up, maintenance and procedures for use.

Duration: 35 Hours

Pre-requisite(s): Block II

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to cylindrical grinding.

2. Describe the considerations used to determine feed and depth of cut for grinding operations.

4. Describe cylindrical grinders, their types, parts, characteristics and applications.

5. Describe the procedures used to plan the sequence for grinding operations.

6. Describe the procedures used to set up grinders and accessories.

7. Describe the procedures used to align the machine.

8. Identify potential set up problems and describe their causes and remedies.

9. Identify types of accessories used for cylindrical grinding operations and describe their applications.

10. Describe the procedures used to maintain cylindrical grinding machines.

11. Describe the procedures used to grind tools and cutters.

12. Describe the procedures used to perform cylindrical grinding operations.

13. Describe the principles and procedures used to parallel grind an internal/external diameter and plunge.

14. Describe operating principles of a centreless grinder.

15. Identify techniques used to troubleshoot cylindrical grinding operations and describe their associated procedures.

Practical Requirements:

1. Grind a workpiece face, internal/external diameter, tapers, plunge and shoulder

MW2041 Cutter and Tool Grinder

Learning Outcomes:

- Demonstrate knowledge of setting up and operating a universal cutter and tool grinder.

Duration: 20 Hours

Pre-requisite(s): Block II

Objectives and Content:

UNIVERSAL CUTTER AND TOOL GRINDER

1. Describe tool and cutter grinders, their parts, applications and safety precautions.

2. Describe tool cutter nomenclature.

3. Describe tool cutter grinder accessories and their applications.

4. Describe the procedures used to set up a tool and cutter grinder.

5. Describe methods used for calculating, grinding and checking clearance angles.

6. Describe the procedures used to grind clearance angles.
   i. clearance grinding
   ii. hollow grinding
   iii. circle grinding

7. Describe potential problems that might be encountered during operations, their causes and remedies.

8. Describe maintenance procedures for tool and cutter grinders.

ENDMILL SHARPENERS

8. Describe endmill sharpeners, their parts, applications and safety precautions.

10. Describe endmill cutting angles.

11. Describe endmill sharpener accessories and their applications.

12. Describe the procedures used to set up endmill sharpeners.

13. Describe methods used for grinding and checking clearance angles.

DRILL SHARPENERS

14. Describe drill sharpeners, their parts, applications and safety precautions.

15. Describe drill cutting angles.

16. Describe drill sharpener accessories and their applications.

17. Describe the procedures used to set up drill sharpeners.

18. Describe methods used for grinding and checking clearance angles.

Practical Requirements:

1. Check cutter clearance angle using appropriate method.

2. Set up and sharpen a cutter using a tool cutter grinder.

3. Set up and sharpen a cutter using an endmill sharpener.

4. Setup and sharpen a drill using a drill sharpener.

MW2101 Surface Grinders

Learning Outcomes:

- Demonstrate knowledge of surface grinders, their set up, maintenance and procedures for use.

Duration: 40 Hours

Pre-requisite(s): Block II

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to surface grinding.
2. Describe the considerations used to determine feed and depth of cut for grinding operations.
3. Calculate feed and depth of cut.
4. Describe the principles of the grinding process.
5. Describe the procedures used to set up grinders and accessories.
6. Describe the procedures used to test a grinding wheel on a surface grinding wheel flange.
7. Describe the procedures used to mount a grinding wheel.
8. Describe the procedures used to balance a grinding wheel.
9. Describe the procedures and precautions used for truing and dressing a grinding wheel.
10. Describe the procedures used to align a workpiece.
11. Identify potential set up problems and describe their causes and remedies.

12. Identify types of surface grinders and accessories used for surface grinding operations and describe their applications.

13. Describe the procedures used to maintain surface grinding machines.

WORK HOLDING DEVICES

14. Identify types of magnetic chucks and describe their operating principles and characteristics.

15. Identify magnetic chuck accessories and describe their applications.
    i. adapter plate
    ii. magnetic chuck blocks
    iii. sine chuck
    iv. Magna-vise clamps
    v. double-face taper
    vi. special fixtures

16. Describe the procedures used to align grinder heads, tables and fixtures.

17. Describe the various types of grinding fluids.

18. Describe the methods of applying coolants.

19. Describe the factors that affect surface finish.

SURFACE GRINDING OPERATIONS

20. Describe the procedures used to perform surface grinding operations.

21. Describe the procedures used for mounting work pieces.

22. Describe the procedures used to set up and perform grinding operations on a surface grinder.
    i. cut off parts
    ii. grind surfaces and shapes

23. Describe the procedures used for dressing a convex radius on a grinding wheel.

24. Identify and correct problems during grinding operations.

25. Identify techniques used to troubleshoot surface grinding operations and describe their associated procedures.

Practical Requirements:

1. Grind previously made workpiece surfaces:
   i. flat
   ii. parallel
   iii. adjacent
   iv. perpendicular

2. True and dress a grinding wheel.

BLOCK IV

MW2090 Bevel, Helical and Worm Gears

Learning Outcomes:

- Demonstrate knowledge various types of gears.
- Demonstrate knowledge setting up and performing gear milling operations.

Duration: 95 Hours

Pre-requisite(s): Block III

Objectives and Content:

BEVEL GEARS

1. Identify the types of bevel gears and their characteristics.

2. Describe the procedures used to set up and mill bevel gears using indexing heads.

3. Describe the procedures used to calculate and mill bevel gears.

HELICAL GEARS

4. Describe the different types of helical gears and their applications.

5. Describe the various applications of helical gears.

6. Describe the procedure for milling helical gears using indexing heads.

7. Describe the procedures used to calculate and mill helical gears.

WORM GEARS

8. Identify the types of worm gears and their use.

9. Describe the calculations for the parts of a worm gear.
   i. addendum
   ii. center distance
   iii. dedendum clearance
   iv. face width
   v. lead of worm thread
   vi. lead angle
   vii. OD
      - worm
      - worm gear
   viii. pitch
      - worm
      - worm gear
   ix. pitch diameter
      - worm
      - worm gear
   x. rubbing speed (fpm)
   xi. throat diameter
   xii. radius of rim corner
   xiii. throat radius
   xiv. ratio
   xv. tooth depth
   xvi. worm thread length

10. Describe the procedures used for hobbing gears.

11. Describe specialty gear cutting equipment.

Practical Requirements:

1. Mill bevel gear using an indexing head.

2. Perform speed and feed calculations.

3. Mill a helical gear.

4. Perform bevel gear and helical gear calculations.

MW2110 Electrical Arc Welding

Learning Outcomes:

- Demonstrate knowledge of basic electric arc welding processes used in machining operations, and their applications.
- Demonstrate knowledge of basic welding symbols

Duration: 45 Hours

Pre-requisite(s): Block III

Objectives and Content:

1. Describe hazards and safe practices associated with arc welding.
   i. welding screens
   ii. ventilation (local exhausts)
   iii. freely movable hood
   iv. fixed enclosure
   v. down draft benches
   vi. confined spaces
   vii. electric shock hazards

2. Identify codes, regulations, training and certification requirements pertaining to welding.

3. Describe the use of PPE associated with arc welding.
   i. eye and face protection
   ii. safety goggles
   iii. welding shields
   iv. welding jackets
   v. gloves
   vi. aprons
   vii. respirators and dust masks
   viii. lense selection

4. Describe procedures used for set up and operation of electric arc welding equipment.
   i. AC and DC machines
   ii. straight and reverse polarity
   iii. grounding methods
   iv. electrode holders
   v. amperage setting for various electrodes
   vi. electrode storage

5. Describe procedures used for set up and operation of MIG (metal inert gas) welding equipment.
   i. gas selection
   ii. grounding methods
   iii. wire types and sizing
   iv. amperage setting

6. Explain the numbering system for electrodes.
   i. tensile strength
   ii. welding position (recommend for the electrode)
   iii. penetration

7. Describe types of joints encountered in welding.
   i. butt
   ii. tee
   iii. lap
   iv. plug
   v. tacking

8. Describe three basic welding positions.
   i. flat
   ii. vertical
   iii. horizontal

9. Identify and interpret welding symbols commonly found on blueprints.

Practical Requirements:

1. Weld a butt joint.

2. Build up on a piece of shafting using arc and MIG then machine to size.

MW2141 Computer Numerical Control (CNC) Operation 2

Learning Outcomes:

- Demonstrate knowledge of basic CNC programming.
- Demonstrate knowledge of CNC machine-tools, their set up, maintenance and procedures for use.

Duration: 100 Hours

Pre-requisite(s): Block III

Objectives and Content:

1. Identify CNC control units and describe their purpose.

2. Describe the use and applications of Computerized Aided Manufacturing (CAM) software.

3. Identify types of basic programming codes and languages and describe their applications.
   i. G-codes
   ii. M-codes
   iii. conversational

4. Identify CNC-related reference points and their location.

5. Describe the procedures used to perform basic CNC programming.
   i. review process documentation
   ii. calculate coordinates for tool path
   iii. create basic program
   iv. input program data into control memory
   v. optimize program

6. Describe the procedures used to set up CNC machines.
   i. send/receive program
   ii. select and set up tooling and tool holder
   iii. tool offsets
   iv. set up workpiece

v. establish work datum
vi. verify program

7. Describe the procedures used to operate CNC machines.
   i. adjust offsets
   ii. load/unload workpiece
   iii. monitor process
   iv. interupt program cycle
   v. restart program cycle

8. Describe the procedures used to perform basic preventative maintenance.

9. Describe the procedure to perform the following CNC processes.
   i. rough turning
   ii. finish turning
   iii. threading (internal/external)
   iv. grooving
   v. boring
   vi. taper turning
   vii. radius turning
   viii. chamfer
   ix. profiling
   x. drilling
   xi. tapping
   xii. pocketing (rectangular & circular)
   xiii. tool offsets
   xiv. cutter compensation (left/right)

10. Describe EDM, their characteristics and applications.
    i. die sink
    ii. wire feed

11. Describe the procedure used to remove broken taps.

12. Describe the procedures used to cut work pieces using EDM.

Practical Requirements:

1. Manually write a program for both the CNC lathe and mill.

2. Operate CAM to produce a drawing or part.

3. Perform the following:
   i. rough and finish turning
   ii. threading (external)
   iii. taper turning
   iv. boring
   v. radius/chamfer turning
   vi. grooving
   vii. pocketing
   viii. drilling
   ix. tapping

4. Load program.

5. Select and set up tooling.

6. Select and set up holding devices.

7. Set tooling off sets.

8. Test run the program.

9. Produce a finished part.

D. Conditions Governing Apprenticeship Training

1.0 General

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

2.0 Entrance Requirements

2.1 Entry into the occupation as an apprentice requires:

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

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

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

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

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

3.0 Probationary Period

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

4.0 Termination of a Memorandum of Understanding

After the probationary period referred to in Section 3.0, the Memorandum of Understanding may be terminated by the PACB by mutual consent of the parties involved, or cancelled by the PACB for proper and sufficient cause in the opinion of the PACB, such as that stated inSection14.

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

Machinist 7200 Hours			
APPRENTICESHIP LEVEL AND WAGES			
Year	Wage Rate At This Level	Requirements for progression to next level of apprenticeship	When requirements are met, the apprentice will progress to…
1st	60 %	▪ Completion of Block 1 (pre-employment) training ▪ Pass block 1 exam ▪ Relevant work experience and training totaling 1800 hours or more	2nd Year
2nd	70%	▪ Completion of Block 2 training ▪ Pass block 2 exam ▪ Relevant work experience and training totaling 3600 hours or more	3rd Year
3rd	80%	▪ Completion of Block 3 training ▪ Pass block 3 exam ▪ Relevant work experience and training totaling 5400 hours or more	4th Year
4th	90%	▪ Completion of Block 4 training ▪ Relevant work experience and training totaling 7200 hours or more ▪ Sign-off of all workplace skills in apprentice logbook ▪ Pass certification exam	Journeyperson Certification

Wage Rates

- 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.

Block Exams

- This program may not currently contain block exams, in which case this requirement will be waived until such time as block exams are available.

Machinist 7200 Hours		
CLASS CALLS		
Call Level	Requirements for Class Call	Hours awarded for In-School Training
Direct Entry Apprentice: PLA & / or Block 1	▪ Minimum of 1000 hours of relevant work experience ▪ Prior Learning Assessment (PLA) at designated college (if applicable)	To be determined by the number of courses completed after each class call
Block 2	▪ Minimum of 3000 hours of relevant work experience and training	240
Block 3	▪ Minimum of 5000 hours of relevant work experience and training	240
Block 4	▪ Minimum of 7000 hours of relevant work experience and training	240

Direct Entry Apprentice:

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

Class calls at Minimum Hours:

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

6.0 Tools

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

7.0 Periodic Examinations and Evaluation

7.1 Every apprentice shall submit to such occupational tests and examinations as the PACB shall direct. If after such occupational tests and examinations the apprentice is found to be making unsatisfactory progress, his/her apprenticeship level and rate of wage shall not be advanced as provided in Section 5 until his/her progress is satisfactory to the Director of Apprenticeship and Trades Certification and his/her date of completion shall be deferred accordingly. Persistent failure to pass required tests shall be a cause for revocation of his/her Memorandum of Understanding.

7.2 Upon receipt of reports of accelerated progress of the apprentice, the PACB may shorten the term of apprenticeship and advance the date of completion accordingly.

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

7.4 Course credits may be granted through the use of a PACB approved matrix which identifies course equivalencies between designated trades and between current and historical Plans of Training for the same trade.

8.0 Granting of Certificates of Apprenticeship

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

9.0 Hours of Work

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

10.0 Copies of the Registration for Apprenticeship

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

11.0 Ratio of Apprentices to Journeypersons

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

12.0 Relationship to a Collective Bargaining Agreement

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

13.0 Amendments to a Plan of Apprenticeship Training

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

14.0 Employment, Re-Employment and Training Requirements

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

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

14.3 Failure to comply with Sections 14.1 and/or 14.2 will result in cancellation of the Memorandum of Understanding. Apprentices may have their MOUs reinstated by the PACB but would be subject to a commitment to complete the entire program as outlined in the General Conditions of Apprenticeship. Permanent cancellation in the said occupation is the result of non-compliance.

14.4 Cancellation of the Memorandum of Understanding to challenge journeyperson examinations, if unsuccessful, would require an apprentice to serve a time penalty of two (2) years before reinstatement as an apprentice or qualifying to receive a class call to training as a registered Trade Qualifier. Cancellation must be mutually agreed upon by the employer and the apprentice.

14.5 An employer shall ensure that each apprentice is under the direct supervision of an approved journeyperson supervisor who is located at the same worksite as the apprentice, and that the apprentice is able to communicate with the journeyperson with respect to the task, activity or function that is being supervised.

14.6 Under the Plan of Training the employer is required to keep each apprentice employed as long as work is available, and if the apprentice is laid off due to lack of work, to give first opportunity to be hired before another is hired.

14.7 The employer will permit each apprentice to attend training programs as prescribed by the PACB.

14.8 Apprentices who cannot acquire all the workplace skills at their place of employment will have to be evaluated in a simulated work environment at a PACB authorized training institution and have sign-off done by instructors to meet the requirements for certification.

15.0 Appeals to Decisions Based on Conditions Governing Apprenticeship Training

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

E. Requirements for Red Seal Endorsement

1. Evidence the required work experiences outlined in this Plan of Training have been obtained. This evidence must be in a format clearly outlining the experiences and must be signed by an appropriate person or persons attesting that these experiences have been obtained to the level required.

2. Successful completion of all required courses in the program.

3. A combination of training from an approved training program and suitable work experience totaling 7200 hours.

   Or

   A total of 9000 hours of suitable work experience.

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

F. Roles and Responsibilities of Stakeholders in the Apprenticeship Process.

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

The Apprentice:

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