COURSE FAB1010: FABRICATION TOOLS & MATERIALS

Level: Introductory

Prerequisite: None

Description: Students develop knowledge and skills in the use of basic hand tools and materials used in fabrication processes, and safely transform common metals into useful products.

Parameters: Access to a materials work centre, complete with basic hand tools.

Outcomes: The student will:

1. **create a health and safety plan with special emphasis on conditions and factors related to the specific pathway or series of courses**
   - 1.1 research and identify the following eight common elements of a health and safety management system:
     - 1.1.1 management, leadership and organizational commitment including policies, guidelines and responsibilities
     - 1.1.2 hazard identification and assessment
     - 1.1.3 hazard control
     - 1.1.4 worker competency and training including: technical competence, safe work practices and procedures, personal protective equipment
     - 1.1.5 work site inspection
     - 1.1.6 incident investigation
     - 1.1.7 emergency response
     - 1.1.8 management system administration including: evaluation, records and statistics, maintenance of system
   - 1.2 explain each of the elements reflecting on occupational health and safety implications
   - 1.3 define health and safety elements relevant to the world-of-work
   - 1.4 present a health and safety plan clarifying its relevance to the work world and society in general
2. **research common processes and methods of hazard identification, assessment and control specific to the pathway or series of courses**
   - 2.1 research and identify common job site hazard identification processes
   - 2.2 research and identify common methods for assessment and control of hazards
   - 2.3 explain and demonstrate appropriate health and safety effective practices
   - 2.4 demonstrate a proactive personal commitment toward improvement of workplace health and safety including concern for others and following instructions, rules and guidelines
3. **identify and describe the safe use of basic hand tools used in fabricating an artifact or structure**
   - 3.1 identify and describe basic hand tools that are used to measure, mark, hold, cut, form, fasten and finish materials
   - 3.2 identify and describe basic tools and equipment used in one or more fabrication processes; e.g., welding, bar, tubular and sheet fabrication, foundry operations, machining

4. **identify and compare the properties of common ferrous and non-ferrous metals used in fabrication processes**
   - 4.1 identify and compare the properties of a variety of ferrous and non-ferrous metals used in fabrication processes
   - 4.2 identify common shapes, sizes and forms of fabrication materials
5. **apply fabrication processes and skills in a safe manner to produce a useful product**
   - 5.1 describe appropriate methods to handle, recycle, store and dispose of materials
   - 5.2 identify and demonstrate the appropriate use of personal protective equipment
   - 5.3 identify steps to be taken in the event of an accident
   - 5.4 outline the typical phases in a production system including:
     - 5.4.1 planning
     - 5.4.2 fabricating
     - 5.4.3 assembling
     - 5.4.4 finishing
     - 5.4.5 evaluating
   - 5.5 select or modify a plan for a simple product that will meet a defined need
   - 5.6 identify and select the appropriate tools, materials and processes required to make the product
   - 5.7 list the steps that are required to make a product in a safe and logical order
   - 5.8 develop basic fabrication skills by building, assembling and finishing a variety of products
   - 5.9 describe ways to improve product quality and productivity
6. **demonstrate basic competencies**
   - 6.1 demonstrate fundamental skills to:
     - 6.1.1 communicate
     - 6.1.2 manage information
     - 6.1.3 use numbers
     - 6.1.4 think and solve problems
   - 6.2 demonstrate personal management skills to:
     - 6.2.1 demonstrate positive attitudes and behaviours
     - 6.2.2 be responsible
     - 6.2.3 be adaptable
     - 6.2.4 learn continuously
     - 6.2.5 work safely
   - 6.3 demonstrate teamwork skills to:
     - 6.3.1 work with others
     - 6.3.2 participate in projects and tasks
7. **make personal connections to the cluster content and processes to inform possible pathway choices**
   - 7.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
   - 7.2 create a connection between a personal inventory and occupational choices

COURSE FAB1040: OXYACETYLENE WELDING

Level: Introductory

Prerequisite: FAB1010: Fabrication Tools & Materials

Description: Students develop basic skills in the safe handling and operation of oxyacetylene equipment.

Parameters: Access to a materials work centre, complete with oxyacetylene welding equipment and fabrication facilities, and to instruction from an individual with formal, specialized training in basic oxyacetylene welding.

Outcomes: The student will:

1. **take preventive measures to avoid accidents and personal injury to self and others by recognizing health and safety hazards associated with oxyacetylene welding**
   - 1.1 describe how oxygen and acetylene gases are produced, stored and transported
   - 1.2 analyze the construction of an oxygen and acetylene cylinder
   - 1.3 explain the purpose and operation of a gas regulator and welding torch
   - 1.4 match the type of gas with the appropriate type of hose, cylinder and threaded connection
   - 1.5 describe how welding tips are sized
   - 1.6 describe how welding tips are cleaned
   - 1.7 describe the hazards associated with oxyacetylene welding in relation to the:
     - 1.7.1 use of personal protective equipment
     - 1.7.2 use of flammable gases under pressure
     - 1.7.3 need to remove or protect all combustible materials around the welding area
   - 1.8 describe a plan of action in the event of an accident
2. **perform safe oxyacetylene start-up and shut-down procedures**
   - 2.1 describe and demonstrate the safe start-up and shut-down procedures for oxyacetylene welding
3. **demonstrate basic oxyacetylene welding competencies**
   - 3.1 describe the characteristics of:
     - 3.1.1 an oxidizing flame
     - 3.1.2 a carburizing flame
     - 3.1.3 a neutral flame
   - 3.2 identify typical weld types; e.g., fillet, groove, plug
   - 3.3 identify typical weld positions; e.g., flat, horizontal, vertical, overhead
   - 3.4 list and describe the basic weld joints; e.g., butt, lap, tee, corner, edge
   - 3.5 prepare a selection of coupons for welding lap joints
   - 3.6 select the appropriate tip for a given application
   - 3.7 identify appropriate gas pressure for proper flame control
   - 3.8 identify the appropriate fire extinguisher in the event of a fire
   - 3.9 demonstrate proficiency in:
     - 3.9.1 creating lines of fusion without using a filler rod
     - 3.9.2 creating lines of fusion with a filler rod
     - 3.9.3 welding fillet welds in the flat position
   - 3.10 complete a visual inspection of a weld by considering the overall appearance, size and shape of the beads, plate penetration, fusion, and degree of undercutting and overlapping

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences

5.2 create a connection between a personal inventory and occupational choices

COURSE FAB1048: SEMI-AUTOMATED/AUTOMATED WELDING

Level: Introductory

Prerequisite: FAB1010: Fabrication Tools & Materials

Description: Students develop basic knowledge and skills related to the use of Gas Metal Arc Welding (GMAW) and Flux Cored Arc Welding (FCAW) processes in both personal use and commercial applications. They also develop introductory knowledge of Submerged Arc Welding (SAW) processes.

Parameters: Access to a fabrication work centre complete with GMAW and/or FCAW equipment and supplies, and to instruction from an individual with formal, specialized training in arc welding practices.

Supporting Course: FAB1050: Basic Electric Welding

Outcomes: The student will:

1. **take preventive measures to avoid accidents and personal injury to self and others by identifying health and safety hazards associated with GMAW, FCAW and SAW**
   - 1.1 identify and explain safety issues related to:
     - 1.1.1 electrical shock
     - 1.1.2 toxic fumes
     - 1.1.3 radiant energy from the arc
   - 1.2 describe a safety plan in case of an accident
   - 1.3 identify basic components and operation principles for GMAW, FCAW and SAW processes
   - 1.4 describe the basic care, handling and storage for GMAW and FCAW wires
2. **identify power sources used in GMAW, FCAW and SAW processes**
   - 2.1 relate knowledge of basic electrical terms to power sources used in GMAW, FCAW and SAW processes
   - 2.2 identify the function of slope and inductance in CV power sources
   - 2.3 demonstrate knowledge of the following basic electrical terms:
     - 2.3.1 direct and alternating current
     - 2.3.2 voltage
     - 2.3.3 amperage
     - 2.3.4 resistance
     - 2.3.5 polarity
     - 2.3.6 open circuit voltage and arc voltage
3. **select appropriate electrode wires and shielding gases for use in GMAW and FCAW processes**
   - 3.1 describe and compare methods of metal transfer in GMAW, FCAW and SAW processes; e.g., short arc, globular, spray arc
   - 3.2 explain the advantages and disadvantages of GMAW, FCAW and SAW processes
   - 3.3 explain the advantages and disadvantages of the following different types of wire feed systems:
     - 3.3.1 push
     - 3.3.2 pull
     - 3.3.3 push–pull
   - 3.4 describe welding gun assemblies for GMAW and FCAW processes
   - 3.5 describe GMAW and FCAW electrode wires
   - 3.6 identify applications for the more commonly used GMAW and FCAW wires

3.7 explain the purpose of shielding gases
3.8 identify different types of shielding gases and explain their effects
3.9 explain the advantages and disadvantages of different shielding gases in specific applications
3.10 describe the purpose and operation of a regulator/flowmeter
3.11 for a given type of weld and/or weldment, select the appropriate:
    3.11.1 wire type, size and feed rate
    3.11.2 current
    3.11.3 shielding gas type and flow rate
3.12 select the appropriate solid/flux cored wire and machine settings

4. perform safe start-up and shut-down procedures for GMAW and/or FCAW processes

4.1 identify different drive roll assemblies
4.2 describe the steps taken to set up GMAW and FCAW equipment including:
    4.2.1 fasten cylinders
    4.2.2 mount regulator/flowmeter
    4.2.3 pressurize/depressurize systems
    4.2.4 set/check drive wheel tension

5. demonstrate safe GMAW and/or FCAW processes on light gauge mild steel and/or mild steel plate in the flat and horizontal positions

5.1 identify typical weld types; e.g., fillet, groove, plug or slot, stud
5.2 identify typical weld positions; e.g., flat, horizontal, vertical, overhead
5.3 list and describe the basic weld joints; e.g., butt, lap, tee, corner, edge
5.4 prepare and clean all surfaces to be welded by removing any:
    5.4.1 oil and/or grease
    5.4.2 paint, rust or scale
5.5 make light-gauge fillet welds in the flat and horizontal positions, using GMAW and/or FCAW equipment
5.6 complete a visual inspection of the weld by observing:
    5.6.1 overall appearance
    5.6.2 size and shape of beads
    5.6.3 plate penetration
    5.6.4 fusion
    5.6.5 degree of undercutting and overlapping

6. demonstrate basic competencies

6.1 demonstrate fundamental skills to:
    6.1.1 communicate
    6.1.2 manage information
    6.1.3 use numbers
    6.1.4 think and solve problems
6.2 demonstrate personal management skills to:
    6.2.1 demonstrate positive attitudes and behaviours
    6.2.2 be responsible
    6.2.3 be adaptable
    6.2.4 learn continuously
    6.2.5 work safely
6.3 demonstrate teamwork skills to:
    6.3.1 work with others
    6.3.2 participate in projects and tasks

7. make personal connections to the cluster content and processes to inform possible pathway choices

7.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences

7.2 create a connection between a personal inventory and occupational choices

COURSE FAB1050: BASIC ELECTRIC WELDING

Level: Introductory

Prerequisite: FAB1010: Fabrication Tools & Materials

Description: Students develop basic skills related to the safe use and operation of one or more common electric welding processes.

Parameters: Access to a materials work centre, complete with electric welding equipment and fabrication facilities, and to instruction from an individual with formal, specialized training in basic Gas Metal Arc Welding (GMAW) and/or Shielded Metal Arc Welding (SMAW).

Outcomes: The student will:

1. **take preventive measures to avoid accidents and personal injury to self and others by identifying health and safety hazards associated with electric welding processes**
   - 1.1 identify and describe the following common electric welding processes and approved abbreviations:
     - 1.1.1 GMAW
     - 1.1.2 Gas Tungsten Arc Welding (GTAW)
     - 1.1.3 SMAW
   - 1.2 describe the hazards associated with GMAW and SMAW
   - 1.3 demonstrate how personal protective equipment is used to protect eyes, skin and respiratory system
   - 1.4 describe a safety plan in case of an accident
   - 1.5 describe the need to remove or protect all combustible materials in the welding area
   - 1.6 identify and locate the appropriate fire extinguisher and fire blanket
2. **perform safe GMAW and/or SMAW start-up and shut-down procedures**
   - 2.1 describe from a weld specification the:
     - 2.1.1 type of equipment to be used
     - 2.1.2 size and type of electrode/wire
     - 2.1.3 weld settings
     - 2.1.4 type of weld, joint and weld position
     - 2.1.5 weld dimensions
   - 2.2 describe the start-up and shut-down procedures for a given piece of equipment
   - 2.3 locate all pertinent safety equipment and clamping apparatus
3. **demonstrate basic arc welding competencies**
   - 3.1 describe how an arc is produced and controlled in GMAW and/or SMAW
   - 3.2 explain the purpose of the electrode coating and/or shielding gas in their respective processes
   - 3.3 identify the essential components and accessories used in GMAW and/or SMAW
   - 3.4 identify typical weld types including:
     - 3.4.1 fillet
     - 3.4.2 groove
     - 3.4.3 plug or slot
     - 3.4.4 surfacing

3.5 identify typical weld positions including:
  3.5.1 flat
  3.5.2 horizontal
  3.5.3 vertical
  3.5.4 overhead
3.6 list and describe the following basic weld joints:
  3.6.1 butt
  3.6.2 lap
  3.6.3 tee
  3.6.4 corner
  3.6.5 edge
3.7 prepare weld surfaces by removing any:
  3.7.1 oil and/or grease
  3.7.2 paint, rust or scale
3.8 demonstrate basic skills in:
  3.8.1 selecting equipment and accessories
  3.8.2 setting machine parameters
  3.8.3 connecting work leads
  3.8.4 striking an arc using a tapping and scratching technique
  3.8.5 running a stringer and weave bead
  3.8.6 performing fillet welds in the flat position using SMAW and GMAW processes
3.9 complete a visual inspection of a weld by considering the overall appearance, size and shape of the bead

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
  4.1.1 communicate
  4.1.2 manage information
  4.1.3 use numbers
  4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
  4.2.1 demonstrate positive attitudes and behaviours
  4.2.2 be responsible
  4.2.3 be adaptable
  4.2.4 learn continuously
  4.2.5 work safely
4.3 demonstrate teamwork skills to:
  4.3.1 work with others
  4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
5.2 create a connection between a personal inventory and occupational choices

COURSE FAB1090: SHEET FABRICATION 1

Level: Introductory

Prerequisite: FAB1010: Fabrication Tools & Materials

Description: Students use basic tools, materials and processes to fabricate sheet materials into finished products, models or prototypes.

Parameters: Access to a materials work centre, complete with basic hand tools.

Outcomes: The student will:

1. **identify and describe the basic tools and processes used to fabricate sheet stock**
   - 1.1 identify the common types and sources of sheet and board stock; e.g., card stock, sheet metal, acrylic plastic, corrugated card and plastic, foam board, styrofoam
2. **demonstrate basic measurement and layout skills and techniques**
   - 2.1 identify and demonstrate the appropriate transfer and marking processes for a variety of sheet and board materials
   - 2.2 prepare a pattern or template to transfer folding and cutting lines
   - 2.3 create a systematic sequence of operations to fabricate a product
   - 2.4 demonstrate basic skills related to the use of:
     - 2.4.1 layout and marking tools
     - 2.4.2 cutting tools
     - 2.4.3 forming tools
     - 2.4.4 bonding materials
     - 2.4.5 fastening devices
3. **apply basic sheet stock fabrication skills and techniques to produce a product**
   - 3.1 describe the process of separating sheet stock by:
     - 3.1.1 shearing
     - 3.1.2 scoring and snapping
     - 3.1.3 sawing
     - 3.1.4 hot wire cutting
   - 3.2 describe the process of forming sheet stock using a:
     - 3.2.1 strip heater
     - 3.2.2 box and pan brake
     - 3.2.3 slip roll
     - 3.2.4 vacuum former
   - 3.3 research typical joining and fastening techniques related to the use of:
     - 3.3.1 mechanical joints and fasteners
     - 3.3.2 adhesive
     - 3.3.3 cohesives
   - 3.4 apply suitable finishes and surface details to a model, prototype or product
   - 3.5 analyze a product for the overall attention to:
     - 3.5.1 workmanship
     - 3.5.2 accuracy
     - 3.5.3 structural soundness
     - 3.5.4 quality of finish

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences

5.2 create a connection between a personal inventory and occupational choices

COURSE FAB1100: FABRICATION PRINCIPLES

Level: Introductory

Prerequisite: FAB1010: Fabrication Tools & Materials

Description: Students investigate and apply fundamental principles of fabrication to build an artifact or structure from common structural materials.

Parameters: Access to a materials work centre, complete with basic hand tools.

Outcomes: The student will:

1. **identify and describe the principles of separating, forming and combining materials**
   - 1.1 list and describe three distinct ways of changing the shape of a material; e.g., separating, forming, combining (joining)
   - 1.2 describe and give examples of tools that:
     - 1.2.1 shear
     - 1.2.2 chip
     - 1.2.3 abrade
   - 1.3 identify other current and emerging processes that use the following to shape a material:
     - 1.3.1 heat
     - 1.3.2 light
     - 1.3.3 chemicals
   - 1.4 outline principal methods of forming materials by:
     - 1.4.1 bending or twisting
     - 1.4.2 forging
     - 1.4.3 casting
   - 1.5 research processes that can be used to:
     - 1.5.1 polish
     - 1.5.2 coat
     - 1.5.3 plate a surface to protect or improve the appearance of a product
   - 1.6 demonstrate basic skills related to separating, combining and forming processes
2. **describe the characteristics and give examples of permanent, semipermanent and temporary fastening systems**
   - 2.1 list and describe common types of mechanical fasteners that are used with metal products
   - 2.2 identify and describe typical bonding techniques that are used to combine metals; e.g., soldering, braze welding, bonding
   - 2.3 describe when to use permanent, semipermanent and temporary fastening techniques
   - 2.4 explain why it may be necessary to change the physical state of some materials before they can be formed
3. **demonstrate basic fabrication skills and techniques, using simple hand and power tools**
   - 3.1 identify and describe measurement and layout tools that can be used to:
     - 3.1.1 measure and mark a straight line on a metal surface
     - 3.1.2 make an angle of 45° and 90°
     - 3.1.3 create arcs and circles
     - 3.1.4 measure the inside and/or outside dimensions of pipe, round and square stock

3.2 for a given product design, describe the appropriate processes and tools to measure, lay out, shape, condition and finish the materials
3.3 prepare a material list and sequence of events to fabricate a given product design
3.4 describe principles of shop safety
3.5 describe a safety plan in case of an accident

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
5.2 create a connection between a personal inventory and occupational choices

COURSE FAB1110: BAR & TUBULAR FABRICATION

Level: Introductory

Prerequisite: FAB1010: Fabrication Tools & Materials

Description: Students use cutting, bending and fastening processes to create a variety of products from bar and tubular stock.

Parameters: Access to a materials work centre, complete with basic hand tools and metal forming equipment.

Outcomes: The student will:

1. **list and describe common shapes and sizes of bar and tubular stock**
   - 1.1 identify common sizes and shapes of bar and tubular stock
2. **demonstrate approved material handling and storage practices**
   - 2.1 describe the most appropriate way to safely store and handle bar and tubular stock
3. **apply basic bar and tubular fabrication skills and techniques to produce a product**
   - 3.1 identify common methods of laying out and marking stock
   - 3.2 describe typical methods of cutting bar and tubular stock to length
   - 3.3 describe how to form:
     - 3.3.1 eyes
     - 3.3.2 circles
     - 3.3.3 scrolls
     - 3.3.4 square and zero bend radii using a metal bender
   - 3.4 describe how to calculate the bend allowance for bar and tubular stock
   - 3.5 calculate the bend allowance for a given radius
   - 3.6 describe when heat is required to bend a bar or tube
   - 3.7 research appropriate fastening techniques using:
     - 3.7.1 mechanical fasteners
     - 3.7.2 welding processes
   - 3.8 describe how to prefinish and finish a bar or tubular product to prevent corrosion and improve appearance
   - 3.9 create a materials list and work schedule from a shop drawing
   - 3.10 demonstrate the safe use of hand- and power-assisted equipment
   - 3.11 describe health and safety issues associated with the use of finishing materials
   - 3.12 describe a safety plan in case of an accident
   - 3.13 demonstrate basic skills related to:
     - 3.13.1 laying out and marking stock
     - 3.13.2 cutting stock to length
     - 3.13.3 bending arcs and angles
     - 3.13.4 fastening components
     - 3.13.5 finishing the product

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences

5.2 create a connection between a personal inventory and occupational choices

COURSE FAB1120: FOUNDRY – ONE-PIECE PATTERN

Level: Introductory

Prerequisite: FAB1010: Fabrication Tools & Materials

Description: Students develop the basic skills required to produce a simple one-piece pattern, a sand mould and a finished casting.

Parameters: Access to a materials work centre, complete with foundry supplies and equipment, and to instruction from an individual with specialized training in basic foundry.

Outcomes: The student will:

1. **take preventive measures to avoid accidents and personal injury to self and others by recognizing health and safety hazards associated with casting metal**
   - 1.1 describe the operation of a foundry furnace and safe methods of handling and pouring molten metal
   - 1.2 list the types of personal protective equipment and the circumstances under which it should be worn
   - 1.3 describe a safety plan in case of an accident
2. **demonstrate basic pattern making skills to make a one-piece mould**
   - 2.1 outline the basic procedures used to make a mould with a one-piece pattern
   - 2.2 list and describe the types of patterns used to make sand moulds
   - 2.3 identify the types of materials that are suitable for making a pattern
   - 2.4 design or locate an article that can be cast using a one-piece pattern
   - 2.5 select a suitable pattern making material
3. **demonstrate basic sand casting skills, using a one-piece pattern**
   - 3.1 list examples of everyday products that are made by casting
   - 3.2 explain how a cast part differs from a forged part
   - 3.3 list common metals used to make castings; e.g., aluminum, brass, bronze, iron
   - 3.4 describe the major casting processes including:
     - 3.4.1 sand casting
     - 3.4.2 die casting
     - 3.4.3 investment casting
   - 3.5 identify and describe the parts of a sand mould
   - 3.6 describe the advantages and disadvantages of a water-moistened sand and an oil-bonded sand
   - 3.7 explain why a flux is used when a metal is melted
   - 3.8 identify common tools and equipment used in sand casting
   - 3.9 describe the kind and amount of metal that is required for a given casting
   - 3.10 describe the melting point and appropriate flux for a specified metal
   - 3.11 evaluate the quality of sand and foundry metal

3.12 use the appropriate tools, materials and processes to:
- 3.12.1 make a pattern
- 3.12.2 condition the sand
- 3.12.3 create a mould
- 3.12.4 heat and pour the molten metal
- 3.12.5 remove and finish the casting

3.13 research a completed casting and check to see that it is clean, free of voids and finished appropriately

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences

5.2 create a connection between a personal inventory and occupational choices

COURSE FAB1130: PRINCIPLES OF MACHINING

Level: Introductory

Prerequisite: FAB1010: Fabrication Tools & Materials

Description: Students develop basic hand and machine tool knowledge, skills and techniques to mechanically remove materials.

Parameters: Access to a materials work centre, complete with a drill press, bench or pedestal grinder and metal lathe, and to instruction from an individual with specialized training in basic machining.

Outcomes: The student will:

1. **identify and describe common machineable materials and machining processes**
   - 1.1 list and describe the principal methods of material removed by:
     - 1.1.1 sawing
     - 1.1.2 shaping
     - 1.1.3 grinding
     - 1.1.4 turning
     - 1.1.5 milling
     - 1.1.6 drilling
     - 1.1.7 buffing
   - 1.2 identify common machineable materials; e.g., aluminum, mild steel, brass, plastic
   - 1.3 research methods of securing stock for purposes of machining; e.g., chuck, vise, clamp
   - 1.4 analyze common hand and machine tool processes of:
     - 1.4.1 cutting and shaping
     - 1.4.2 grinding and polishing
     - 1.4.3 threading metal stock
   - 1.5 compare the performance of manually operated and computer-controlled equipment in relation to:
     - 1.5.1 accuracy
     - 1.5.2 repeatability
     - 1.5.3 reliability
     - 1.5.4 productivity
   - 1.6 explain how the proper drill speeds and feed rates are determined
2. **perform safe set-up, operation and shut-down of equipment used in drilling, grinding and turning operations**
   - 2.1 list and describe the safety hazards associated with drilling
   - 2.2 describe the major components and operation of a metal lathe
   - 2.3 list and describe the safety hazards associated with turning
   - 2.4 list and describe the safety hazards associated with grinding
   - 2.5 demonstrate basic skills in:
     - 2.5.1 measurement and layout
     - 2.5.2 drilling, grinding and turning operations to size, shape and finish a complete product

3. demonstrate basic hand and machine tool knowledge, skills and techniques

- 3.1 describe the current systems of measurement used in machining and explain the advantages and disadvantages of each
- 3.2 list and describe common types of rules, squares, dividers, callipers, micrometers and gauges that are used in connection with machining
- 3.3 identify the major components and describe the operation of a drill press
- 3.4 research the design of a typical twist drill and methods of sizing
- 3.5 describe the purpose and list the types of lubrication that are used when drilling
- 3.6 identify the appropriate cutting tool to face metal stock
- 3.7 explain what is meant by cutting speed, feed rate and depth of cut and how these variables are expressed and controlled
- 3.8 identify the major components and operation of a bench or pedestal grinder
- 3.9 identify and describe different kinds of grinding wheels
- 3.10 explain why it is important not to overheat thin edges or points and not to grind soft metals
- 3.11 identify the types and uses of cloth abrasives
- 3.12 select or modify a product that incorporates:
  - 3.12.1 drilling
  - 3.12.2 grinding
  - 3.12.3 turning operations
- 3.13 describe the machining operations and sequence them in a logical and efficient manner
- 3.14 research a completed product to determine whether it meets the specified tolerances and quality of finish

4. demonstrate basic competencies

- 4.1 demonstrate fundamental skills to:
  - 4.1.1 communicate
  - 4.1.2 manage information
  - 4.1.3 use numbers
  - 4.1.4 think and solve problems
- 4.2 demonstrate personal management skills to:
  - 4.2.1 demonstrate positive attitudes and behaviours
  - 4.2.2 be responsible
  - 4.2.3 be adaptable
  - 4.2.4 learn continuously
  - 4.2.5 work safely
- 4.3 demonstrate teamwork skills to:
  - 4.3.1 work with others
  - 4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

- 5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
- 5.2 create a connection between a personal inventory and occupational choices

COURSE FAB1160: PRODUCTION SYSTEMS

Level: Introductory

Prerequisite: FAB1010: Fabrication Tools & Materials

Description: Students investigate and compare the principles of production operation and the characteristics of a number of production systems.

Parameters: Access to a materials work centre, complete with basic hand and power tools, and to instruction from an individual with specialized training in the use of basic hand and power tools.

Outcomes: The student will:

1. list and describe common methods of manufacturing durable products
- 1.1 when selecting a product, explain the importance of:
  - 1.1.1 appeal
  - 1.1.2 ease of manufacture
  - 1.1.3 use of standardized parts
  - 1.1.4 quality
  - 1.1.5 cost
- 1.2 help prepare a flow chart that:
  - 1.2.1 combines the worker, machines and materials in an organized unit
  - 1.2.2 requires minimal movement of the worker and materials
  - 1.2.3 identifies specific operations
- 1.3 explain the importance of providing for:
  - 1.3.1 personal and environmental safety
  - 1.3.2 easy access to utilities
  - 1.3.3 ventilation
  - 1.3.4 lighting
  - 1.3.5 waste disposal
  - 1.3.6 material and product handling
- 1.4 help design jigs, templates and fixtures based on:
  - 1.4.1 ease of use
  - 1.4.2 ability to reduce error
  - 1.4.3 cost and safety
- 1.5 help design, construct and operate a production system
- 1.6 identify when a product is at standard, needs reworking or should be rejected

2. demonstrate basic production planning and management skills
- 2.1 list and describe the following four basic types of manufacturing systems:
  - 2.1.1 custom
  - 2.1.2 job lot
  - 2.1.3 continuous
  - 2.1.4 just-in-time
- 2.2 describe safety rules and guidelines associated with the task and working conditions
- 2.3 identify common hazards associated with the use of a specific tool, machining material or process
- 2.4 inspect for and correct potential hazards within the working environment

2.5 describe a safety plan in case of an accident
2.6 select a manufacturing system based on the:
    2.6.1 number of products to be produced
    2.6.2 availability of resources
    2.6.3 type of product
    2.6.4 life cycle and durability of a product
2.7 describe what tools, materials and processes will be required to manufacture the product

3. demonstrate basic competencies

3.1 demonstrate fundamental skills to:
    3.1.1 communicate
    3.1.2 manage information
    3.1.3 use numbers
    3.1.4 think and solve problems
3.2 demonstrate personal management skills to:
    3.2.1 demonstrate positive attitudes and behaviours
    3.2.2 be responsible
    3.2.3 be adaptable
    3.2.4 learn continuously
    3.2.5 work safely
3.3 demonstrate teamwork skills to:
    3.3.1 work with others
    3.3.2 participate in projects and tasks

4. make personal connections to the cluster content and processes to inform possible pathway choices

4.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
4.2 create a connection between a personal inventory and occupational choices

COURSE FAB1910: FAB PROJECT A

Level: Introductory

Prerequisite: None

Description: Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

Parameters: Introductory project courses must connect with a minimum of two CTS courses, one of which must be at the introductory level and be in the same occupational area as the project course. The other CTS course(s) can be either at the same level or at the intermediate level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. **identify the connection between this project course and two or more CTS courses**
   - 1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
   - 1.2 explain how these outcomes are being connected to the project and/or performance deliverables
2. **propose the project and/or performance**
   - 2.1 identify the project and/or performance by:
     - 2.1.1 preparing a plan
     - 2.1.2 clarifying the purposes
     - 2.1.3 defining the deliverables
     - 2.1.4 specifying time lines
     - 2.1.5 explaining terminology, tools and processes
     - 2.1.6 defining resources; e.g., materials, costs, staffing
   - 2.2 identify and comply with all related health and safety standards
   - 2.3 define assessment standards (indicators for success)
   - 2.4 present the proposal and obtain necessary approvals

The student will:

3. **meet goals as defined within the plan**
   - 3.1 complete the project and/or performance as outlined
   - 3.2 monitor the project and/or performance and make necessary adjustments
   - 3.3 present the project and/or performance, indicating the:
     - 3.3.1 outcomes attained
     - 3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
5.2 create a connection between a personal inventory and occupational choices

COURSE FAB2010: STRUCTURAL ENGINEERING

Level: Intermediate

Prerequisite: FAB1010: Fabrication Tools & Materials

Description: Students investigate the nature of forces and structural materials and apply their findings to design and fabrication activities.

Parameters: Access to a fabrication work centre, complete with basic hand tools.

Supporting Course: FAB1100: Fabrication Principles

Outcomes: The student will:

1. list and describe the principal characteristics of all structures
- 1.1 through the analysis of natural and fabricated (synthetic) forms, explain how:
  - 1.1.1 structural elements provide both shape and support
  - 1.1.2 structures are built to withstand forces of nature, applied loads and the weights of the structural components
  - 1.1.3 loads applied to a structure generate forces that must be kept in balance
  - 1.1.4 most structures are built with a margin of safety
- 1.2 identify, from natural and synthetic structures, examples of:
  - 1.2.1 frame
  - 1.2.2 shell
  - 1.2.3 non-rigid structures
- 1.3 identify natural and synthetic structural materials that have good:
  - 1.3.1 tensile strength
  - 1.3.2 compressive strength
  - 1.3.3 elasticity
- 1.4 list typical structural components that are used as:
  - 1.4.1 linear elements, such as a beam
  - 1.4.2 vertical elements, such as a column
  - 1.4.3 non-rigid elements, such as a cable
- 1.5 explain the purpose of rigid and non-rigid materials that are used between linear and vertical elements; e.g., plywood and canvas
- 1.6 describe the advantages and disadvantages of non-rigid structures

2. identify strategies to improve the efficiency of a structure
- 2.1 show how triangulation is used to stabilize a truss and rectangular frame
- 2.2 show how internal forces are created to balance external loads
- 2.3 analyze an existing structure and redesign it to increase its efficiency by:
  - 2.3.1 reducing weight yet maintaining strength
  - 2.3.2 enhancing its durability and usefulness
  - 2.3.3 reducing material and construction costs

3. apply principles of structural design to fabrication and construction activities

- 3.1 demonstrate the effects of moving a load close to or away from the neutral axis of a beam
- 3.2 compare the connecting limits of adhesive and cohesive materials and rigid fasteners
- 3.3 describe the effects of the following forces on a simple rigid structure:
  - 3.3.1 compression
  - 3.3.2 tension
  - 3.3.3 shear
  - 3.3.4 bending
  - 3.3.5 twisting
- 3.4 demonstrate the effects one element has on another when it fails
- 3.5 fabricate a structure or component using common materials, tools and contemporary design principles
- 3.6 analyze and test a structure or component to determine its:
  - 3.6.1 strength-to-weight ratio
  - 3.6.2 cost efficiency
  - 3.6.3 service and construction limitations

4. demonstrate basic competencies

- 4.1 demonstrate fundamental skills to:
  - 4.1.1 communicate
  - 4.1.2 manage information
  - 4.1.3 use numbers
  - 4.1.4 think and solve problems
- 4.2 demonstrate personal management skills to:
  - 4.2.1 demonstrate positive attitudes and behaviours
  - 4.2.2 be responsible
  - 4.2.3 be adaptable
  - 4.2.4 learn continuously
  - 4.2.5 work safely
- 4.3 demonstrate teamwork skills to:
  - 4.3.1 work with others
  - 4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

- 5.1 recognize and then analyze the opportunities and barriers in the immediate environment
- 5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2020: PRINT READING

Level: Intermediate

Prerequisite: None

Description: Students develop basic skills in reading and interpreting working drawings to prepare a bill of materials and sequence of operations.

Parameters: Access to appropriate print resources and to instruction from an individual with specialized training in print reading.

Outcomes: The student will:

1. identify and describe the principal components of a print

- 1.1 describe the types of drawings that are used to visualize an object pictorially and orthographically
- 1.2 identify and describe the types of lines commonly found on a drawing; e.g., object, hidden, centre line, dimension
- 1.3 research dimensioning systems used to identify:
  - 1.3.1 linear dimensions
  - 1.3.2 angular dimensions
  - 1.3.3 limits, fits and tolerance
- 1.4 identify the types of threaded fasteners and methods of representation; e.g., detailed, schematic
- 1.5 identify the types of non-threaded fasteners and methods of representation; e.g., detailed, symbols
- 1.6 explain how prints are used to create a:
  - 1.6.1 bill of materials
  - 1.6.2 cutting list
  - 1.6.3 schedule of operations

2. demonstrate basic print reading skills

- 2.1 identify the symbols used to describe:
  - 2.1.1 types of materials
  - 2.1.2 structural shapes
  - 2.1.3 seams and joints
  - 2.1.4 fabrication processes
- 2.2 read and interpret symbols denoting weld types and structural shapes
- 2.3 match pictorial and orthographic drawings that have:
  - 2.3.1 a surface parallel to the viewing plane
  - 2.3.2 hidden edges or surfaces
  - 2.3.3 inclined and oblique surfaces
  - 2.3.4 curved surfaces and holes
- 2.4 read and interpret multiview prints to determine object sizes, shapes and fabrication specifications
- 2.5 read and interpret the size, type and location of threaded and non-threaded fasteners
- 2.6 prepare a list of materials and sequence of machine/tool operations from a given print
- 2.7 outline the importance of accurate prints and print reading skills to ensure high standards of quality and productivity

3. demonstrate basic competencies

3.1 demonstrate fundamental skills to:
- 3.1.1 communicate
- 3.1.2 manage information
- 3.1.3 use numbers
- 3.1.4 think and solve problems

3.2 demonstrate personal management skills to:
- 3.2.1 demonstrate positive attitudes and behaviours
- 3.2.2 be responsible
- 3.2.3 be adaptable
- 3.2.4 learn continuously
- 3.2.5 work safely

3.3 demonstrate teamwork skills to:
- 3.3.1 work with others
- 3.3.2 participate in projects and tasks

4. identify possible life roles related to the skills and content of this cluster

4.1 recognize and then analyze the opportunities and barriers in the immediate environment

4.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2030: OXYFUEL WELDING

Level: Intermediate

Prerequisite: FAB1040: Oxyacetylene Welding

Description: Students develop basic skills in the safe and efficient use of oxyfuel equipment and supplies to braze and fusion weld.

Parameters: Access to a fabrication work centre, complete with oxyfuel welding equipment and supplies, and to instruction from an individual with formal, specialized training in oxyfuel welding practices.

Outcomes: The student will:

1. **describe the essential differences between braze welding and fusion welding**
   - 1.1 describe the differences between braze welding and fusion welding
   - 1.2 list the advantages and disadvantages of braze welding
   - 1.3 demonstrate basic fusion welding skills in the flat, vertical and horizontal positions
2. **demonstrate basic braze welding competencies**
   - 2.1 describe health and safety issues such as:
     - 2.1.1 using the appropriate personal protective equipment and clothing
     - 2.1.2 keeping the welding area free of combustible materials
     - 2.1.3 ensuring adequate ventilation, particularly when braze welding
     - 2.1.4 returning and storing all consumables, as directed
     - 2.1.5 locating appropriate fire extinguishers in the event of a fire
   - 2.2 describe the appropriate clearance allowed between parts of a braze weldment
   - 2.3 demonstrate basic skills in braze welding in the flat and horizontal positions
3. **demonstrate basic oxyfuel weld competencies in the flat, horizontal and vertical positions**
   - 3.1 describe the appropriate moving, storing and set-up procedures
   - 3.2 identify local codes and restrictions related to the use and storage of oxygen and acetylene cylinders
   - 3.3 describe the alternative gases available for heating; their comparative temperatures and applications such as MAPP and propane
   - 3.4 select the correct filler rod and tip size for a given application
   - 3.5 set working gas pressures to match the tip size
   - 3.6 prepare a destructive and non-destructive weld assessment
   - 3.7 research applications of oxyfuel welding
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment
5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2040: THERMAL CUTTING

Level: Intermediate

Prerequisite: FAB1040: Oxyacetylene Welding

Description: Students develop basic skills to use, safely and efficiently, thermal cutting equipment and supplies.

Parameters: Access to a fabrication work centre, complete with thermal cutting equipment, and to instruction from an individual with formal, specialized training in oxyfuel cutting practices.

Outcomes: The student will:

1. **take preventive measures to avoid accidents and personal injury to self and others by identifying health and safety hazards associated with thermal cutting**
   - 1.1 identify the workplace labels and precautionary procedures when using:
     - 1.1.1 compressed gas
     - 1.1.2 flammable materials
     - 1.1.3 oxidizing materials
     - 1.1.4 electrical equipment
   - 1.2 review a safety plan in case of an accident
   - 1.3 locate the recommended fire extinguisher
   - 1.4 locate and wear the appropriate personal protective equipment
   - 1.5 locate and clear the work station of all combustible materials
2. **identify safe start-up and shut-down cutting procedures**
   - 2.1 describe the correct way to start a cut and pierce a hole
   - 2.2 describe the appropriate method to:
     - 2.2.1 start an arc
     - 2.2.2 set stand-off distance
     - 2.2.3 control the kerf
   - 2.3 describe correct start-up and shut-down procedures
3. **demonstrate basic manual cutting operations**
   - 3.1 describe common metals that can be successfully cut using:
     - 3.1.1 oxyfuel
     - 3.1.2 air carbon arc
     - 3.1.3 shielded metal arc
     - 3.1.4 plasma arc processes
   - 3.2 describe the oxyfuel process in relation to:
     - 3.2.1 ignition temperature and identification
     - 3.2.2 slag and oxide removal
   - 3.3 identify the types of cutting fuels, their operating temperatures and their efficiency ratios
   - 3.4 identify the parts of a cutting torch and their function
   - 3.5 describe the relationship between tip size, metal thickness and gas pressures
   - 3.6 describe the factors controlling tip selection; e.g., depth of cut, type of material, condition of metal, type and quality of cut

3.7 describe the plasma arc process in relation to:
  3.7.1 arc formation
  3.7.2 cutting gas
  3.7.3 cooling
  3.7.4 dross formation
3.8 identify and describe the purpose of the parts of a plasma arc cutting system
3.9 list the advantages of using a plasma arc cutting system
3.10 select and adjust the appropriate equipment for a given cutting operation
3.11 demonstrate the use of oxyfuel equipment to cut straight edges and bevels, curves and holes in mild steel plate
3.12 demonstrate the use of plasma arc to cut:
  3.12.1 straight and curved cuts
  3.12.2 holes in ferrous and non-ferrous metals
3.13 demonstrate the safe use of carbon arc gouging equipment
3.14 inspect a cut and determine ways to improve the quality of the cut related to the size of the preheating flame, oxygen pressure, cutting speed and different machine settings, gas pressures, and cutting speeds for plasma arc cutting

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
  4.1.1 communicate
  4.1.2 manage information
  4.1.3 use numbers
  4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
  4.2.1 demonstrate positive attitudes and behaviours
  4.2.2 be responsible
  4.2.3 be adaptable
  4.2.4 learn continuously
  4.2.5 work safely
4.3 demonstrate teamwork skills to:
  4.3.1 work with others
  4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment
5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2048: FLUX CORED ARC WELDING 1

Level: Intermediate

Prerequisite: FAB1048: Semi-automated/Automated Welding

Description: Students develop an understanding of the advantages and disadvantages of Flux Cored Arc Welding (FCAW) processes, and they gain experience using FCAW processes by performing flat, horizontal and vertical fillet welds and flat groove welds.

Parameters: Access to a fabrication work centre, complete with FCAW equipment and supplies, and to instruction from an individual with formal, specialized training in arc welding practices.

Outcomes: The student will:

1. **outline the advantages and disadvantages of FCAW processes versus other forms of arc welding processes**
   - 1.1 identify the advantages and disadvantages of FCAW processes as compared with other arc welding processes
   - 1.2 identify the variables that can directly affect weld quality; e.g., the welding current and voltage, modes of metal transfer such as short arc, globular and spray arc, diameter and type of filler metal, type and condition of equipment, welding technique such as forehand or pushing, backhand or pulling
   - 1.3 identify possible causes of welding defects; e.g., surface porosity, subsurface porosity, lack of fusion, burn-through, lack of penetration, cold lapping
   - 1.4 identify problems common to out-of-position welding
2. **describe the characteristics of a desirable flux cored arc weld**
   - 2.1 complete a visual inspection, i.e., non-destructive test, by observing and assessing:
     - 2.1.1 overall size, shape and appearance of the beads
     - 2.1.2 plate penetration
     - 2.1.3 fusion
     - 2.1.4 degree of undercutting and overlapping
3. **identify safe set-up and maintenance procedures with FCAW equipment**
   - 3.1 describe and demonstrate the maintenance required for wire drive systems and gun assemblies
4. **demonstrate safe FCAW practices and perform:**
   - **fillet welds on mild steel plate in the flat, horizontal and vertical positions**
   - **groove welds on mild steel plate in the flat position**
   - 4.1 describe safety issues related to:
     - 4.1.1 using personal protective equipment
     - 4.1.2 handling and storing consumables
     - 4.1.3 keeping the welding area free of hazards
     - 4.1.4 ensuring adequate ventilation
   - 4.2 describe a safety plan in case of an accident
   - 4.3 apply safe work practices and procedures to:
     - 4.3.1 select and use appropriate personal protective equipment
     - 4.3.2 maintain a clean and tidy workstation
     - 4.3.3 demonstrate safe tool/material handling and storage techniques

4.4 for a given type of weld and/or weldment, select the appropriate:
    4.4.1 wire type, size and feed rate
    4.4.2 current
    4.4.3 shielding gas type and flow rate
4.5 prepare and clean all surfaces to be welded
4.6 properly position metal for welding
4.7 demonstrate safe FCAW techniques and perform fillet welds in the flat, horizontal and vertical positions on mild steel plate
4.8 demonstrate safe FCAW techniques and perform groove welds in the flat position on mild steel plate
4.9 perform a destructive test, where appropriate

5. demonstrate basic competencies

5.1 demonstrate fundamental skills to:
    5.1.1 communicate
    5.1.2 manage information
    5.1.3 use numbers
    5.1.4 think and solve problems
5.2 demonstrate personal management skills to:
    5.2.1 demonstrate positive attitudes and behaviours
    5.2.2 be responsible
    5.2.3 be adaptable
    5.2.4 learn continuously
    5.2.5 work safely
5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster

6.1 recognize and then analyze the opportunities and barriers in the immediate environment
6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2050: ARC WELDING 1

Level: Intermediate

Prerequisite: FAB1050: Basic Electric Welding

Description: Students develop basic knowledge, skills and attitudes related to the operation and use of Shielded Metal Arc Welding (SMAW) equipment and accessories to make a variety of welds in the flat position.

Parameters: Access to a fabrication work centre, complete with SMAW equipment and supplies, and to instruction from an individual with formal, specialized training in arc welding practices.

Outcomes: The student will:

1. **identify the appropriate treatment for minor injuries associated with welding processes**
   - 1.1 demonstrate and describe the procedures for administering first aid for minor cuts, burns and bruises
   - 1.2 explain the effects of arc flash and the suggested treatment
   - 1.3 describe the effects of inadequate ventilation and the suggested treatment
2. **describe the visual characteristics of a desirable weld**
   - 2.1 identify the attributes of a quality weld
   - 2.2 inspect a weld by considering the overall appearance, size and shape of the beads, plate penetration, fusion, undercutting and overlapping
3. **demonstrate basic SMAW competencies in the flat position**
   - 3.1 demonstrate knowledge of the following electrical terms:
     - 3.1.1 direct current
     - 3.1.2 alternating current
     - 3.1.3 voltage
     - 3.1.4 amperage
     - 3.1.5 resistance
     - 3.1.6 polarity
     - 3.1.7 open circuit voltage and arc voltage
   - 3.2 compare the operation and current output produced by a:
     - 3.2.1 transformer
     - 3.2.2 rectifier
     - 3.2.3 generator
   - 3.3 explain the meaning of duty cycle
   - 3.4 describe the construction and sizing of cables
   - 3.5 compare the different types of electrode holders and maintenance requirements
   - 3.6 identify the types and uses of cable lugs, quick connectors and work clamps
   - 3.7 describe and demonstrate the accepted methods of striking an arc
   - 3.8 describe the difference between a stringer bead and a weave bead
   - 3.9 describe and demonstrate the proper tacking procedures and weld profile for a flat fillet weld
   - 3.10 adjust the equipment to coincide with the type of electrode, type of weld and metal thickness
   - 3.11 lay a consistent and even stringer bead and/or weave bead in the flat position
   - 3.12 run a series of stringer beads in the flat position to create a layer of weld metal
   - 3.13 make lap and square butt welds on mild steel plate in the flat position

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment

5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2060: ARC WELDING 2

Level: Intermediate

Prerequisite: FAB2050: Arc Welding 1

Description: Students identify appropriate electrodes by visually assessing a weld and making the necessary adjustments to improve weld quality while developing horizontal position welding skills.

Parameters: Access to a fabrication work centre, complete with Shielded Metal Arc Welding (SMAW) equipment and supplies, and to instruction from an individual with formal, specialized training in arc welding practices.

Outcomes: The student will:

1. **explain the current systems used to classify electrodes in Canada and the United States**
   - 1.1 describe the purpose of the core wire and electrode coating
   - 1.2 identify the characteristics of an electrode using American Welding Society (AWS) and Canadian Standards Association (CSA) codes
   - 1.3 show the relationship between metal thickness, electrode size and welding amperage
   - 1.4 describe the electrode(s) that can be used for a given application by considering:
     - 1.4.1 properties of the base metal
     - 1.4.2 weld position
     - 1.4.3 flux requirements
     - 1.4.4 material thickness
     - 1.4.5 static and dynamic load characteristics
2. **identify strategies to assess and improve weld quality**
   - 2.1 compare straight and reverse polarity and the resulting heat distribution
   - 2.2 describe the advantages and disadvantages of using alternating and direct current
   - 2.3 describe the effects of a short and long arc on mild steel
   - 2.4 describe the effects of improper:
     - 2.4.1 amperage setting
     - 2.4.2 arc length
     - 2.4.3 travel speed
   - 2.5 explain the importance of removing the following from a joint before welding:
     - 2.5.1 oil
     - 2.5.2 paint
     - 2.5.3 rust
     - 2.5.4 mill scale
   - 2.6 inspect a weld by considering the overall appearance, size and shape of the beads, plate penetration, fusion and degree of undercutting and overlapping
3. **demonstrate basic SMAW competencies in the horizontal position**
   - 3.1 use the appropriate electrode and machine setting to make single and multiple pass fillet in the horizontal position and groove welds in the flat position

4. demonstrate basic competencies

- 4.1 demonstrate fundamental skills to:
  - 4.1.1 communicate
  - 4.1.2 manage information
  - 4.1.3 use numbers
  - 4.1.4 think and solve problems
- 4.2 demonstrate personal management skills to:
  - 4.2.1 demonstrate positive attitudes and behaviours
  - 4.2.2 be responsible
  - 4.2.3 be adaptable
  - 4.2.4 learn continuously
  - 4.2.5 work safely
- 4.3 demonstrate teamwork skills to:
  - 4.3.1 work with others
  - 4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

- 5.1 recognize and then analyze the opportunities and barriers in the immediate environment
- 5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2070: GAS METAL ARC WELDING 1

Level: Intermediate

Prerequisite: FAB1048: Semi-automated/Automated Welding

Description: Students develop an understanding of the advantages and disadvantages of Gas Metal Arc Welding (GMAW) processes, and they gain experience using GMAW processes by performing flat, horizontal and vertical fillet welds and flat groove welds.

Parameters: Access to a fabrication work centre, complete with GMAW equipment and supplies, and to instruction from an individual with formal, specialized training in arc welding practices.

Outcomes: The student will:

1. **outline the advantages and disadvantages of GMAW processes versus other forms of arc welding processes**
   - 1.1 identify the advantages and disadvantages of GMAW processes as compared with other arc welding processes
   - 1.2 identify the variables that can directly affect weld quality; e.g., the welding current and voltage, modes of metal transfer such as short arc, globular and spray arc, diameter and type of filler metal, type and condition of equipment, welding technique such as forehand or pushing, backhand or pulling
   - 1.3 identify possible causes of welding defects; e.g., surface porosity, subsurface porosity, lack of fusion, burn-through, lack of penetration, cold lapping
   - 1.4 identify problems common to out-of-position welding
2. **describe the characteristics of a desirable GMAW**
   - 2.1 complete a visual inspection, i.e., non-destructive test, by observing and assessing:
     - 2.1.1 overall size, shape and appearance of the beads
     - 2.1.2 plate penetration
     - 2.1.3 fusion
     - 2.1.4 degree of undercutting and overlapping
   - 2.2 perform a destructive test, where appropriate
3. **identify safe set-up and maintenance procedures with GMAW equipment**
   - 3.1 apply safe work practices and procedures to:
     - 3.1.1 select and use appropriate personal protective equipment
     - 3.1.2 maintain a clean and tidy workstation
     - 3.1.3 demonstrate safe tool/material handling and storage techniques
   - 3.2 for a given type of weld and/or weldment, select the appropriate:
     - 3.2.1 wire type, size and feed rate
     - 3.2.2 current
     - 3.2.3 shielding gas type and flow rate
   - 3.3 describe and demonstrate the maintenance required for wire drive systems and gun assemblies

4. demonstrate safe GMAW practices to perform:

- **fillet welds on mild steel plate in the flat, horizontal and vertical positions**
- **groove welds on mild steel plate in the flat position**

4.1 describe safety issues related to:
- 4.1.1 using personal protective equipment
- 4.1.2 handling and storing consumables
- 4.1.3 keeping the welding area free of hazards
- 4.1.4 ensuring adequate ventilation

4.2 describe a safety plan in case of an accident

4.3 prepare and clean all surfaces to be welded

4.4 properly position metal for welding

4.5 demonstrate safe GMAW techniques and perform fillet welds in the flat, horizontal and vertical positions on mild steel plate

4.6 demonstrate safe GMAW techniques and perform groove welds in the flat position on mild steel plate

5. demonstrate basic competencies

5.1 demonstrate fundamental skills to:
- 5.1.1 communicate
- 5.1.2 manage information
- 5.1.3 use numbers
- 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
- 5.2.1 demonstrate positive attitudes and behaviours
- 5.2.2 be responsible
- 5.2.3 be adaptable
- 5.2.4 learn continuously
- 5.2.5 work safely

5.3 demonstrate teamwork skills to:
- 5.3.1 work with others
- 5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster

6.1 recognize and then analyze the opportunities and barriers in the immediate environment

6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2090: SHEET FABRICATION 2

Level: Intermediate

Prerequisite: FAB1090: Sheet Fabrication 1

Description: Students use basic layout, cutting, bending and fastening operations to transform common types of sheet metals into consumer products.

Parameters: Access to a fabrication work centre, complete with basic sheet metal cutting, forming and fastening tools, and to instruction from an individual with specialized training in sheet metal practices.

Outcomes: The student will:

1. **identify and describe common types of stock sheet metal materials and related tools**
   - 1.1 identify common samples of sheet metal stock by their appearance and properties
   - 1.2 explain how sheet metal thicknesses are measured and stated
   - 1.3 explain the safe use of hand and machine tools to make internal and external cuts that are:
     - 1.3.1 straight
     - 1.3.2 curved
   - 1.4 explain the safe use of hand and machine tools to form a product
2. **demonstrate approved materials handling and storage practices**
   - 2.1 describe the most appropriate way to safely handle and store metal stock
3. **perform basic sheet metal fabrication skills and practices to produce a product**
   - 3.1 describe and give examples of uses for:
     - 3.1.1 flange/butt
     - 3.1.2 lap
     - 3.1.3 folded
     - 3.1.4 grooved seams
   - 3.2 calculate the appropriate hem and seam allowances for a given product
   - 3.3 describe the advantages and disadvantages of:
     - 3.3.1 tinner's rivets
     - 3.3.2 pop rivets
   - 3.4 identify the common sizes and types of metal fastening screws and bolts
   - 3.5 identify appropriate conditions and techniques to solder or weld a seam
   - 3.6 calculate and mark the sequence and direction of all bends
   - 3.7 demonstrate basic sheet metal process and fabrication skills related to the following procedures:
     - 3.7.1 layout
     - 3.7.2 cutting
     - 3.7.3 bending
     - 3.7.4 fastening
   - 3.8 inspect a completed rectangular product for the overall attention to:
     - 3.8.1 fit of seams
     - 3.8.2 accuracy of measurement
     - 3.8.3 structural soundness
     - 3.8.4 quality of finish
   - 3.9 research common finishing techniques

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment

5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2100: SHEET FABRICATION 3

Level: Intermediate

Prerequisite: FAB2090: Sheet Fabrication 2

Description: Students expand sheet metal skills related to pattern making, seam constructing and edge treating.

Parameters: Access to a fabrication work centre, complete with basic sheet forming and fastening tools, and to instruction from an individual with specialized training in sheet metal practices.

Outcomes: The student will:

1. **describe and give examples of parallel line developments**
   - 1.1 list and describe the following pattern developments:
     - 1.1.1 parallel line
     - 1.1.2 radial line
     - 1.1.3 triangulations
2. **create a parallel line development, using standard drawing and layout practices**
   - 2.1 prepare a parallel line development
   - 2.2 create a systematic sequence of operations to fabricate a parallel line product
   - 2.3 identify and describe the purpose of a:
     - 2.3.1 standing edge
     - 2.3.2 single hem
     - 2.3.3 double hem
     - 2.3.4 wired edge
   - 2.4 describe how to calculate the material allowance for a wire edge
   - 2.5 explain the use of the following patterns:
     - 2.5.1 full
     - 2.5.2 half
     - 2.5.3 pierced
   - 2.6 identify and describe the use of the following seams:
     - 2.6.1 plain lap and flush lap
     - 2.6.2 inside and outside lap
     - 2.6.3 single and double seam
     - 2.6.4 grooved joint
     - 2.6.5 Pittsburgh lock
   - 2.7 calculate the material allowance for a:
     - 2.7.1 double and a single seam
     - 2.7.2 Pittsburgh lock
3. **apply sheet metal fabrication principles and skills to fabricate a product, using parallel line development**
   - 3.1 explain how to provide adequate air quality for welding, soldering and finishing
   - 3.2 describe:
     - 3.2.1 the use of appropriate personal protective equipment
     - 3.2.2 proper storage of consumables
     - 3.2.3 a safety plan in case of an accident

3.3 explain how and when to use:
    3.3.1 combination, straight and aviation snips
    3.3.2 notchers
    3.3.3 squaring shears
3.4 explain how to sweat solder lap, single- and double-seamed joints
3.5 explain when it is appropriate to use:
    3.5.1 spot welders
    3.5.2 solid rivets
    3.5.3 pop rivets
3.6 describe how to forge and tin solder coppers
3.7 select the appropriate flux for ferrous and non-ferrous applications
3.8 demonstrate basic sheet metal process and fabrication skills related to specific seam and edge treatments and fastening techniques
3.9 list criteria to assess a sheet metal product and apply it to the evaluation of a completed product

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment
5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2110: FORGING FUNDAMENTALS

Level: Intermediate

Prerequisite: FAB1110: Bar & Tubular Fabrication

Description: Students determine the effects of heating and striking metal to change its shape and internal structure, using forging techniques.

Parameters: Access to a fabrication work centre, complete with heating and forging equipment, and to instruction from an individual with specialized training in forging practices.

Supporting Course: FAB1100: Fabrication Principles

Outcomes: The student will:

1. **take preventive measures to avoid accidents and personal injury to self and others by identifying health and safety hazards associated with metal forging**
   - 1.1 identify the appropriate personal protective equipment used in forging
   - 1.2 describe the approved start-up and shut-down procedures for a given forge
   - 1.3 create a sequence of forging operations by analyzing an existing forged part or shop drawing
2. **identify and describe the basic tools and processes used in forging**
   - 2.1 identify common and machine parts that are made by forging
   - 2.2 identify and describe the types of hand tools that are used in forging
   - 2.3 describe the use of:
     - 2.3.1 hammers
     - 2.3.2 tongs
     - 2.3.3 sets
     - 2.3.4 fullers
     - 2.3.5 punches
     - 2.3.6 swages
   - 2.4 describe the parts of a solid fuel or gas-fired forge
   - 2.5 explain how temperatures are controlled
   - 2.6 describe the chemical reactions that take place between the heating elements and the work piece
   - 2.7 describe how the combination of heating and quenching can be used to control the shaping of the metal
   - 2.8 describe the processes of hardening, tempering, annealing and normalizing related to forging
   - 2.9 compare the process of drop forging with those of conventional forging techniques
3. **demonstrate basic metal forging skills and practices**
   - 3.1 compare the grain structure of a part shaped by forging with one shaped by casting or machining
   - 3.2 observe and note the processes of:
     - 3.2.1 tapering
     - 3.2.2 drawing out
     - 3.2.3 bending
     - 3.2.4 twisting
     - 3.2.5 upsetting
   - 3.3 demonstrate basic forging skills using a variety of forging tools

4. demonstrate basic competencies

- 4.1 demonstrate fundamental skills to:
  - 4.1.1 communicate
  - 4.1.2 manage information
  - 4.1.3 use numbers
  - 4.1.4 think and solve problems
- 4.2 demonstrate personal management skills to:
  - 4.2.1 demonstrate positive attitudes and behaviours
  - 4.2.2 be responsible
  - 4.2.3 be adaptable
  - 4.2.4 learn continuously
  - 4.2.5 work safely
- 4.3 demonstrate teamwork skills to:
  - 4.3.1 work with others
  - 4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

- 5.1 recognize and then analyze the opportunities and barriers in the immediate environment
- 5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2120: FOUNDRY – SPLIT PATTERN

Level: Intermediate

Prerequisite: FAB1120: Foundry – One-piece Pattern

Description: Students expand their pattern making and foundry skills to produce split pattern moulds and finished castings.

Parameters: Access to a fabrication work centre, complete with foundry equipment and supplies, and to instruction from an individual with specialized training in foundry practices.

Outcomes: The student will:

1. **describe the essential similarities and differences between a one-piece pattern and a split pattern**
   - 1.1 from a selection of cast objects, list those made from two-part patterns and identify the parting line on each casting
   - 1.2 describe the type of pattern used to make a mould for cylindrical/spherical objects
   - 1.3 explain how a split pattern is aligned and why this is necessary
   - 1.4 compare the shrinkage allowances for:
     - 1.4.1 aluminum
     - 1.4.2 brass
     - 1.4.3 cast iron
   - 1.5 explain how the two parts of the mould are aligned correctly
2. **describe safe start-up and shut-down procedures for the operation of a foundry furnace**
   - 2.1 identify safe start-up and shut-down procedures for a given furnace
   - 2.2 identify appropriate fluxes to be used with the melting process
   - 2.3 identify the dangers related to:
     - 2.3.1 handling ceramic crucibles
     - 2.3.2 moisture in contact with molten metal
     - 2.3.3 metals splashing
     - 2.3.4 moulds incorrectly vented
     - 2.3.5 metal escape if mating flask surfaces are damaged
     - 2.3.6 water as a sand binder
     - 2.3.7 fumes from metal, fluxing and binders
   - 2.4 identify common foundry practices to avoid injury in all of the above
3. **demonstrate basic pattern making skills to make a split pattern**
   - 3.1 list and describe common foundry furnaces and accessories
   - 3.2 describe the correct use of foundry tools and equipment to make a mould from a two-part pattern
   - 3.3 describe the correct pouring temperature for both aluminum alloy and lead-based alloys
   - 3.4 describe a safety plan in case of an accident
4. **apply sand casting principles and skills to make a casting from a split pattern**
   - 4.1 use the appropriate tools, materials and processes to:
     - 4.1.1 construct a split pattern
     - 4.1.2 create a sand mould
     - 4.1.3 pour

4.1.4 cool
4.1.5 remove flash, gates and runners
4.1.6 finish a sand casting

4.2 identify the cause of porosity in a casting and take appropriate measures to correct the problem

5. demonstrate basic competencies

5.1 demonstrate fundamental skills to:
5.1.1 communicate
5.1.2 manage information
5.1.3 use numbers
5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
5.2.1 demonstrate positive attitudes and behaviours
5.2.2 be responsible
5.2.3 be adaptable
5.2.4 learn continuously
5.2.5 work safely

5.3 demonstrate teamwork skills to:
5.3.1 work with others
5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster

6.1 recognize and then analyze the opportunities and barriers in the immediate environment
6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2130: PRECISION TURNING 1

Level: Intermediate

Prerequisite: FAB1130: Principles of Machining

Description: Students develop basic turning skills to size, shape and finish common machineable metals and plastics.

Parameters: Access to a fabrication work centre, complete with a metal lathe and accessories, and to instruction from an individual with specialized training in machining practices.

Outcomes: The student will:

1. **take preventive measures to avoid accidents and personal injury to self and others by identifying health and safety hazards specific to metal turning**
   - 1.1 describe safety procedures related to the use and operation of metal turning equipment
   - 1.2 identify and correct common hazards related to machine lathe and turning processes
   - 1.3 describe a safety plan in case of an accident
   - 1.4 compare the machining characteristics of common ferrous and non-ferrous materials
2. **identify safe metal lathe set-up, operation and shut-down procedures**
   - 2.1 describe the basic parts and accessories of an engine lathe
   - 2.2 explain the difference between a three- and a four-jaw chuck
   - 2.3 identify cutting and forming tools that are used for:
     - 2.3.1 roughing
     - 2.3.2 facing
     - 2.3.3 drilling
     - 2.3.4 boring
     - 2.3.5 parting
     - 2.3.6 knurling
     - 2.3.7 finishing
   - 2.4 describe the correct procedures to:
     - 2.4.1 mount work in a three- and/or four-jaw chuck
     - 2.4.2 mount work between centres
   - 2.5 describe set-up procedures to face, centre drill, straight turn and drill stock
   - 2.6 describe the factors that affect spindle speed, feed rate and depth of cut
   - 2.7 describe safe finishing techniques when using files and abrasives
   - 2.8 identify and describe lathe and lathe tool lubricants and coolants
3. **demonstrate basic straight turning and finishing skills**
   - 3.1 from a machine drawing of a turned part identify:
     - 3.1.1 overall dimension
     - 3.1.2 types of materials
     - 3.1.3 types of finishes
     - 3.1.4 fits and tolerances
   - 3.2 list and describe the machining operations in a logical order
   - 3.3 calculate the appropriate cutting speeds, feed rates and depth of cuts for rough turning, finishing, drilling and knurling different materials

3.4 demonstrate basic turning skills related to the following for common machineable metals and/or plastics:
- 3.4.1 facing
- 3.4.2 centre drilling
- 3.4.3 straight turning
- 3.4.4 drilling
- 3.4.5 boring
- 3.4.6 knurling
- 3.4.7 parting
- 3.4.8 finishing

3.5 research ways to improve output quality and reduce machining time

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment

5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2140: PRECISION MILLING 1

Level: Intermediate

Prerequisite: FAB1130: Principles of Machining

Description: Students develop basic milling skills to shape and finish common machineable metals and plastics.

Parameters: Access to a fabrication work centre, complete with a vertical and/or a horizontal mill and accessories, and to instruction from an individual with specialized training in machining practices.

Outcomes: The student will:

1. **take preventive measures to avoid accidents and personal injury to self and others by identifying health and safety hazards specific to milling operations**
   - 1.1 observe all safety procedures related to the use and operation of metal milling equipment
   - 1.2 describe a safety plan in case of an accident
2. **identify safe milling machine set-up, operation and shut-down procedures**
   - 2.1 research typical set-up procedures for horizontal and/or vertical milling to create flat surfaces, grooves and chamfers
   - 2.2 compare the operation and uses of a vertical mill with the operation and uses of a horizontal mill
   - 2.3 identify and describe the types of cutters used in vertical and horizontal milling according to their size, construction and purpose; e.g., plain milling, side milling, end milling cutters
   - 2.4 use the recommended lubricants for a given milling machine
   - 2.5 identify the purpose of a cutting fluid and identify common types
   - 2.6 identify the factors that determine cutting speeds, feed rates and depths of cuts
   - 2.7 explain the advantages and disadvantages of upcutting and climb milling
3. **demonstrate basic milling machine skills and practices**
   - 3.1 identify and describe the basic parts and accessories of a milling machine
   - 3.2 identify, from a machine drawing of a milled part, the:
     - 3.2.1 overall dimensions and tolerance
     - 3.2.2 quality of surface finish
     - 3.2.3 most appropriate milling machine and cutters to be used
   - 3.3 list and describe the machining operations to square stock, bevel and chamfer surfaces
   - 3.4 calculate the appropriate cutting speeds, feed rates and depth of cuts for a specific operation
   - 3.5 demonstrate basic competencies using a milling machine to rough size, square, bevel, chamfer and finish machine parts to the prescribed tolerances and specification
   - 3.6 research ways to improve output quality and machining time
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment
5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2150: CNC TURNING

Level: Intermediate

Prerequisite: FAB1130: Principles of Machining

Description: Students develop skills in computer-assisted design (CAD) and computer numerical control (CNC) programming to manufacture a product on a CNC lathe.

Parameters: Access to a fabrication work centre, complete with a CNC turning centre, and to instruction from an individual with specialized training in CNC practices.

Outcomes: The student will:

1. **take preventive measures to avoid accidents and personal injury to self and others by identifying safety hazards associated with CNC equipment**
   - 1.1 describe the safety features that are built into the CNC equipment
   - 1.2 describe the:
     - 1.2.1 appropriate use of protective equipment and clothing
     - 1.2.2 need to keep the work area clean and free of hazards
     - 1.2.3 importance of following the manufacturer's instructions and keeping all guards in place and in working order
   - 1.3 describe a safety plan in case of an accident
2. **demonstrate two-dimensional programming and/or CAD skills**
   - 2.1 identify the relationship of the *x* and *y* axis on a metal lathe
   - 2.2 explain how to program a lathe using absolute coordinates
   - 2.3 compare the advantages of using incremental and absolute systems of measurements
   - 2.4 explain the difference between using a fixed zero and full floating zero
   - 2.5 describe the purpose of G and M codes
   - 2.6 explain how canned cycles are used in programming
   - 2.7 explain how a CAD file can be converted to a machineable part file
3. **apply CNC programming skills to manufacture a turned part**
   - 3.1 describe the principles of machining and the operation of a metal lathe
   - 3.2 analyze a CNC lathe and describe how turning speeds and feed rates are controlled; tools and work pieces are mounted
   - 3.3 identify the turning capabilities of a lathe; e.g., types of materials, set-ups, cutting tools
   - 3.4 prepare a program from a print using absolute coordinates and/or produce a CAD design
   - 3.5 simulate the tool path using computer graphics
   - 3.6 load the program or convert a CAD file
   - 3.7 identify reference and clearance points
   - 3.8 mount and secure the work piece
   - 3.9 mount and set cutting tool(s)
   - 3.10 complete a test run
   - 3.11 manufacture the part
   - 3.12 inspect the part to see that it meets the print dimensions, tolerances and specifications

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment

5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2160: CUSTOM FABRICATION

Level: Intermediate

Prerequisite: FAB1010: Fabrication Tools & Materials

Description: Students work independently, or in a cooperative learning environment, to plan and construct a product/structure that meets a specific client's needs.

Parameters: Access to fabrication facilities and equipment and to instruction from an individual with trade qualifications if students are involved in customer work related to welding and other trade-related activities.

Supporting Course: FAB1160: Production Systems

Outcomes: The student will:

1. **demonstrate appropriate communicating and planning skills**
   - 1.1 list the steps to follow in determining a customer's needs
   - 1.2 identify the product/structure specifications through consultation with the customer
   - 1.3 create a suitable design, time line and budget by working collaboratively with the customer
   - 1.4 explain to the customer any need to make changes
   - 1.5 complete change orders the customer sees as necessary
   - 1.6 complete a customer satisfaction follow-up
   - 1.7 explain whether any specialized equipment will be needed to complete the task
   - 1.8 describe any unique finishing and installation requirements
   - 1.9 describe the advantages and disadvantages of custom production
2. **demonstrate effective resource management skills and practices**
   - 2.1 identify and describe key management elements such as:
     - 2.1.1 organizing
     - 2.1.2 designing
     - 2.1.3 producing
     - 2.1.4 controlling
   - 2.2 explain the need to:
     - 2.2.1 identify group and individual responsibilities
     - 2.2.2 identify and capitalize on individual strengths
     - 2.2.3 participate in group as well as self-evaluative processes
     - 2.2.4 develop strategies for positive criticism
   - 2.3 explain a method to gain new leads
   - 2.4 research ways to determine customer satisfaction
3. **demonstrate custom fabrication competencies**
   - 3.1 describe the advantages and disadvantages of custom production
   - 3.2 identify the types and properties of the materials to be used
   - 3.3 evaluate the need to construct special jigs or fixtures
   - 3.4 complete responsibilities to:
     - 3.4.1 break out materials according to a prearranged plan
     - 3.4.2 process materials with a minimum number of set-ups
     - 3.4.3 assemble, finish and prepare the product/structure for delivery or installation
   - 3.5 identify future service requirements

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment

5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2170: PIPE FITTING

Level: Intermediate

Prerequisite: FAB1010: Fabrication Tools & Materials

Description: Students learn about the uses of pipes, basic piping principles and fabrication skills.

Parameters: Access to a fabrication work centre, complete with cutting, threading and assembly tools, and to instruction from an individual with specialized training in pipe cutting and fitting practices.

Supporting Course: FAB1110: Bar & Tubular Fabrication

Outcomes: The student will:

1. identify and describe common pipe fitting materials and applications

- 1.1 research and describe the types of piping systems used to provide:
  - 1.1.1 gas supply systems
  - 1.1.2 sprinkler systems
  - 1.1.3 hot water and heating services
  - 1.1.4 steam and superheated steam
  - 1.1.5 cooling systems
  - 1.1.6 petroleum and chemical products
- 1.2 identify and provide applications for:
  - 1.2.1 standard pipe (black and galvanized)
  - 1.2.2 thin wall pipe
  - 1.2.3 extra strong pipe
- 1.3 research and give examples of how common piping materials are coded and specified
- 1.4 list and describe the following components found in piping systems:
  - 1.4.1 flanges and fittings
  - 1.4.2 valves
  - 1.4.3 traps
  - 1.4.4 pumps
- 1.5 describe the appropriate type and size of pipe, fittings and components for a given drawing
- 1.6 calculate the length of a given offset

2. demonstrate approved methods of joining common types of pipes and materials

- 2.1 describe appropriate applications and methods of joining pipe by:
  - 2.1.1 threading
  - 2.1.2 welding
  - 2.1.3 using mechanical fasteners
- 2.2 describe how to join dissimilar pipe materials; e.g., steel pipe to copper, steel pipe to plastic
- 2.3 analyze various methods to measure pipe lengths and calculate offsets
- 2.4 identify appropriate methods of laying, hanging and securing pipe

2.5 identify all safety procedures related to:
    2.5.1 using personal protective clothing
    2.5.2 lifting heavy weights
    2.5.3 using ladders and scaffolds
    2.5.4 using tools and materials
2.6 describe a safety plan in case of an accident
2.7 use the appropriate tools to make a small pipe assembly that incorporates a variety of fittings and components
2.8 test a simple pipe assembly for:
    2.8.1 accuracy
    2.8.2 tightness of joints
    2.8.3 overall workmanship

3. demonstrate basic competencies

3.1 demonstrate fundamental skills to:
    3.1.1 communicate
    3.1.2 manage information
    3.1.3 use numbers
    3.1.4 think and solve problems
3.2 demonstrate personal management skills to:
    3.2.1 demonstrate positive attitudes and behaviours
    3.2.2 be responsible
    3.2.3 be adaptable
    3.2.4 learn continuously
    3.2.5 work safely
3.3 demonstrate teamwork skills to:
    3.3.1 work with others
    3.3.2 participate in projects and tasks

4. identify possible life roles related to the skills and content of this cluster

4.1 recognize and then analyze the opportunities and barriers in the immediate environment
4.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2910: FAB PROJECT B

Level: Intermediate

Prerequisite: None

Description: Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

Parameters: Intermediate project courses must connect with a minimum of two CTS courses, one of which must be at the intermediate level and be in the same occupational area as the project course. The other CTS course(s) can be at any level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. **identify the connection between this project course and two or more CTS courses**
   - 1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
   - 1.2 explain how these outcomes are being connected to the project and/or performance deliverables
2. **propose the project and/or performance**
   - 2.1 identify the project and/or performance by:
     - 2.1.1 preparing a plan
     - 2.1.2 clarifying the purposes
     - 2.1.3 defining the deliverables
     - 2.1.4 specifying time lines
     - 2.1.5 explaining terminology, tools and processes
     - 2.1.6 defining resources; e.g., materials, costs, staffing
   - 2.2 identify and comply with all related health and safety standards
   - 2.3 define assessment standards (indicators for success)
   - 2.4 present the proposal and obtain necessary approvals

The student will:

3. **meet goals as defined within the plan**
   - 3.1 complete the project and/or performance as outlined
   - 3.2 monitor the project and/or performance and make necessary adjustments
   - 3.3 present the project and/or performance, indicating the:
     - 3.3.1 outcomes attained
     - 3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment
5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2920: FAB PROJECT C

Level: Intermediate

Prerequisite: None

Description: Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

Parameters: Intermediate project courses must connect with a minimum of two CTS courses, one of which must be at the intermediate level and be in the same occupational area as the project course. The other CTS course(s) can be at any level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. **identify the connection between this project course and two or more CTS courses**
   - 1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
   - 1.2 explain how these outcomes are being connected to the project and/or performance deliverables
2. **propose the project and/or performance**
   - 2.1 identify the project and/or performance by:
     - 2.1.1 preparing a plan
     - 2.1.2 clarifying the purposes
     - 2.1.3 defining the deliverables
     - 2.1.4 specifying time lines
     - 2.1.5 explaining terminology, tools and processes
     - 2.1.6 defining resources; e.g., materials, costs, staffing
   - 2.2 identify and comply with all related health and safety standards
   - 2.3 define assessment standards (indicators for success)
   - 2.4 present the proposal and obtain necessary approvals

The student will:

3. **meet goals as defined within the plan**
   - 3.1 complete the project and/or performance as outlined
   - 3.2 monitor the project and/or performance and make necessary adjustments
   - 3.3 present the project and/or performance, indicating the:
     - 3.3.1 outcomes attained
     - 3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment
5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB2950: FAB INTERMEDIATE PRACTICUM

Level: Intermediate

Prerequisite: None

Description: Students apply prior learning and demonstrate the attitudes, skills and knowledge required by an external organization to achieve a credential/credentials or an articulation.

Parameters: This practicum course, which may be delivered on- or off-campus, should be accessed only by students continuing to work toward attaining a recognized credential/credentials or an articulation offered by an external organization. This course must be connected to at least one CTS course from the same occupational area and cannot be used in conjunction with any advanced (3XXX) level course. A practicum course cannot be delivered as a stand-alone course, cannot be combined with a CTS project course and cannot be used in conjunction with the Registered Apprenticeship Program or the Green Certificate Program.

Outcomes: The student will:

1. perform assigned tasks and responsibilities, as required by the organization granting the credential(s) or articulation

- 1.1 identify regulations and regulatory bodies related to the credential(s) or articulation
- 1.2 describe personal roles and responsibilities, including:
  - 1.2.1 key responsibilities
  - 1.2.2 support functions/responsibilities/expectations
  - 1.2.3 code of ethics and/or conduct
- 1.3 describe personal work responsibilities and categorize them as:
  - 1.3.1 routine tasks; e.g., daily, weekly, monthly, yearly
  - 1.3.2 non-routine tasks; e.g., emergencies
  - 1.3.3 tasks requiring personal judgement
  - 1.3.4 tasks requiring approval of a supervisor
- 1.4 demonstrate basic employability skills and perform assigned tasks and responsibilities related to the credential(s) or articulation

2. analyze personal performance in relation to established standards

- 2.1 evaluate application of the attitudes, skills and knowledge developed in related CTS courses
- 2.2 evaluate standards of performance in terms of:
  - 2.2.1 quality of work
  - 2.2.2 quantity of work
- 2.3 evaluate adherence to workplace legislation related to health and safety
- 2.4 evaluate the performance requirements of an individual who is trained, experienced and employed in a related occupation in terms of:
  - 2.4.1 training and certification
  - 2.4.2 interpersonal skills
  - 2.4.3 technical skills
  - 2.4.4 ethics

3. demonstrate basic competencies

3.1 demonstrate fundamental skills to:
- 3.1.1 communicate
- 3.1.2 manage information
- 3.1.3 use numbers
- 3.1.4 think and solve problems

3.2 demonstrate personal management skills to:
- 3.2.1 demonstrate positive attitudes and behaviours
- 3.2.2 be responsible
- 3.2.3 be adaptable
- 3.2.4 learn continuously
- 3.2.5 work safely

3.3 demonstrate teamwork skills to:
- 3.3.1 work with others
- 3.3.2 participate in projects and tasks

4. identify possible life roles related to the skills and content of this cluster

4.1 recognize and then analyze the opportunities and barriers in the immediate environment

4.2 identify potential resources to minimize barriers and maximize opportunities

COURSE FAB3010: MATERIALS TESTING

Level: Advanced

Prerequisite: FAB1010: Fabrication Tools & Materials

Description: Students are introduced to the principles of materials testing and to the development and evaluation of a mechanical materials test.

Parameters: Access to common hand and power assisted tools and to instruction from an individual with specialized training in materials testing.

Supporting Courses: FAB1100: Fabrication Principles
DES1020: The Design Process

Outcomes: The student will:

1. **describe the purpose and nature of materials testing**
   - 1.1 identify and describe common methods of testing materials; e.g., non-destructive, destructive
   - 1.2 explain how test results are recorded and communicate a plan showing how to anticipate the results of a test
   - 1.3 identify common hazards associated with the use of a specific tool, material and/or process
   - 1.4 identify and correct potential hazards within the working environment
   - 1.5 describe a safety plan in case of an accident
2. **apply testing principles to construct or use a piece of materials testing apparatus**
   - 2.1 design a piece of testing apparatus or test procedure
   - 2.2 create safety controls
   - 2.3 construct testing devices
   - 2.4 identify type of test, calibration and data recovery
   - 2.5 prepare the materials, as required
3. **test and compare the properties of common materials used in construction and fabrication**
   - 3.1 conduct a given test on a variety of materials and record the test results
   - 3.2 analyze an existing piece of test equipment and describe its:
     - 3.2.1 purpose
     - 3.2.2 operation
     - 3.2.3 method of calibration and data recovery
   - 3.3 compare the data obtained from the materials tested to anticipated results
   - 3.4 explain the reliability of the testing procedure
   - 3.5 identify the advantages/disadvantages of the test being carried out
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

COURSE FAB3020: METALLURGY FUNDAMENTALS

Level: Advanced

Prerequisite: FAB1010: Fabrication Tools & Materials

Description: Students develop fundamental understanding and skills related to metallurgy and apply these skills to fabrication processes.

Parameters: Access to a fabrication work centre, complete with heat treating equipment, and to instruction from an individual with specialized training in heat treating practices.

Supporting Course: FAB3010: Materials Testing

Outcomes: The student will:

1. **identify and describe the fundamental principles of metallurgy and its industrial applications**
   - 1.1 list and describe the three major fields of metallurgy; i.e., extractive, mechanical, physical
   - 1.2 explain how the principles of metallurgy are used in:
     - 1.2.1 welding
     - 1.2.2 foundry
     - 1.2.3 mechanically forming and finishing metals
   - 1.3 explain the relationship between the properties of a metal and its structure
   - 1.4 describe the effects of adding greater or lesser percentages of carbon to the strength, hardness and brittleness of steel
   - 1.5 describe the effects of cooling on the size and shape of a crystal
2. **identify the basic alloy components and properties of common alloys**
   - 2.1 use terms to describe the internal structure of metals; e.g., atomic structure, compound, solution, crystal
   - 2.2 compare the effects of heating and cooling on steel with varying carbon contents
   - 2.3 identify elements that are dissolved together to form common alloys including:
     - 2.3.1 steel
     - 2.3.2 bronze
     - 2.3.3 brass
     - 2.3.4 aluminum
   - 2.4 identify the basic alloy components and common uses of the following steel types:
     - 2.4.1 carbon
     - 2.4.2 alloy
     - 2.4.3 tool
     - 2.4.4 stainless
   - 2.5 describe common methods of identifying ferrous and non-ferrous materials such as spark, magnetic and specific gravity tests
   - 2.6 describe the electrochemical nature of corrosion
   - 2.7 identify common methods of reducing corrosion; e.g., protective coating, oxide layers, alloys

3. apply metallurgical principles, skills and processes to heat treat a component or product

- 3.1 describe the process and purpose of:
  - 3.1.1 quenching
  - 3.1.2 normalizing
  - 3.1.3 annealing
  - 3.1.4 tempering
  - 3.1.5 surface hardening
- 3.2 explain how heat treating principles are applied to welding and other fabrication processes
- 3.3 explain how cold working differs from heat treating
- 3.4 determine the procedures and critical temperatures to heat treat one or more of the following tools:
  - 3.4.1 wood chisel
  - 3.4.2 screwdriver
  - 3.4.3 centre punch
  - 3.4.4 cold chisel
- 3.5 describe the safe start-up and shut-down procedures of a heat treating furnace
- 3.6 use the appropriate materials, processes and tools to fabricate and condition a new product or make repairs on an existing product
- 3.7 research ways to test a product for hardness and toughness

4. demonstrate basic competencies

- 4.1 demonstrate fundamental skills to:
  - 4.1.1 communicate
  - 4.1.2 manage information
  - 4.1.3 use numbers
  - 4.1.4 think and solve problems
- 4.2 demonstrate personal management skills to:
  - 4.2.1 demonstrate positive attitudes and behaviours
  - 4.2.2 be responsible
  - 4.2.3 be adaptable
  - 4.2.4 learn continuously
  - 4.2.5 work safely
- 4.3 demonstrate teamwork skills to:
  - 4.3.1 work with others
  - 4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

- 5.1 identify short-term and long-term goals
- 5.2 identify steps to achieve goals

COURSE FAB3030: GAS TUNGSTEN ARC WELDING

Level: Advanced

Prerequisite: FAB2030: Oxyfuel Welding

Description: Students develop basic knowledge and skills related to the use of Gas Tungsten Arc Welding (GTAW) equipment and supplies to weld mild steel in the flat and horizontal positions.

Parameters: Access to a welding facility, complete with GTAW equipment and supplies, and to instruction from an individual with welding trade qualifications.

Supporting Courses: FAB2060: Arc Welding 2
FAB2070: Gas Metal Arc Welding 1

Outcomes: The student will:

1. **take preventive measures to avoid accidents and personal injury to self and others by identifying health and safety hazards associated with GTAW**
   - 1.1 identify and describe the health and safety issues associated with GTAW, including:
     - 1.1.1 electric current
     - 1.1.2 inert gases
     - 1.1.3 arc radiation
     - 1.1.4 ventilation
   - 1.2 describe a safety plan in case of an accident
2. **outline the advantages of GTAW over other forms of welding**
   - 2.1 describe the basic components and operating principles of GTAW
   - 2.2 identify the advantages of GTAW over other forms of arc welding
   - 2.3 describe the major types of power supplies and current outputs; e.g., high frequency current, alternating current (AC), direct current straight polarity (DCSP), direct current reverse polarity (DCRP)
3. **demonstrate basic GTAW competencies in the flat and horizontal positions**
   - 3.1 identify the appropriate type of current used for welding:
     - 3.1.1 low carbon steel
     - 3.1.2 aluminium
     - 3.1.3 stainless steel
   - 3.2 explain the purpose of a shielding gas
   - 3.3 identify the appropriate type of gas to be used with:
     - 3.3.1 low carbon steel
     - 3.3.2 aluminium
     - 3.3.3 stainless steel
   - 3.4 select, prepare and install the appropriate electrode for:
     - 3.4.1 AC
     - 3.4.2 DCSP or direct current electrode negative (DCEN) welding
     - 3.4.3 DCRP or direct current electrode positive (DCEP) welding
   - 3.5 identify and demonstrate the appropriate start-up and shut-down procedures for welding mild steel
   - 3.6 show that mill scale, rust, paint or oil has been removed from the weldments

3.7 list the characteristics of a weld that meets trade standards
3.8 demonstrate proper handling techniques to prevent weld contamination
3.9 identify the degreasers that are commonly used to clean filler materials
3.10 describe the correct torch angle for a lap and groove weld in the flat, horizontal and vertical positions
3.11 make lap and groove welds in the flat, horizontal and vertical positions
3.12 perform a visual inspection of a weld and describe its characteristics

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

COURSE FAB3040: SPECIALIZED WELDING

Level: Advanced

Prerequisite: FAB2030: Oxyfuel Welding

Description: Students develop specific skills associated with advanced welding techniques to join and repair metals other than low carbon steel.

Parameters: Access to a welding facility, complete with advanced level welding equipment and supplies, and to instruction from an individual with welding trade qualifications.

Supporting Courses: FAB3030: Gas Tungsten Arc Welding
FAB3050: Arc Welding 3
FAB3170: Gas Metal Arc Welding 2

Outcomes: The student will:

1. **list specific health and safety hazards associated with welding metals other than low carbon steels, and take preventive measures to avoid accidents and personal injury to self and others**
   - 1.1 describe the health hazards connected with welding metals containing zinc, cadmium, lead, tin and chromium
   - 1.2 describe a safety plan in case of an accident
2. **describe the unique welding characteristics of weldable metals other than low carbon steel**
   - 2.1 research and describe the unique welding characteristics of:
     - 2.1.1 stainless steel
     - 2.1.2 cast iron
     - 2.1.3 aluminum
     - 2.1.4 white metal (zinc die cast metal)
3. **select appropriate filler material and welding process to weld a metal other than low carbon steel**
   - 3.1 identify a suitable filler metal and flux to join or repair:
     - 3.1.1 stainless steel
     - 3.1.2 cast iron
     - 3.1.3 aluminum
     - 3.1.4 white metal (zinc die cast metal)
   - 3.2 identify the appropriate joint preparation, supports and techniques for a given metal
   - 3.3 perform a weld or repair on one or more metals other than a low carbon steel
   - 3.4 complete a visual inspection by considering the overall appearance, size and shape of the beads and degree of penetration
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

COURSE FAB3048: FLUX CORED ARC WELDING 2

Level: Advanced

Prerequisite: FAB2048: Flux Cored Arc Welding 1

Description: Students develop skills to evaluate and improve the quality of Flux Cored Arc Welding (FCAW), and they extend their FCAW skills by performing horizontal and vertical groove welds.

Parameters: Access to a fabrication work centre, complete with FCAW equipment and supplies, and to instruction from an individual with welding trade qualifications.

Outcomes: The student will:

1. identify variables that affect the quality of flux core arc welds and identify strategies to evaluate and improve weld quality

- 1.1 identify the variables that can directly affect weld quality including the:
  - 1.1.1 welding current and voltage
  - 1.1.2 type of shielding gas/flux
  - 1.1.3 diameter and type of filler metal
  - 1.1.4 type and condition of equipment
  - 1.1.5 welding technique
- 1.2 select the appropriate shielding gas mixture based on the:
  - 1.2.1 mode of metal transfer
  - 1.2.2 base metal type and thickness
  - 1.2.3 joint design
  - 1.2.4 filler material
  - 1.2.5 desired weld quality
- 1.3 describe how to select the type and size of filler metal
- 1.4 explain how to avoid contamination of filler materials
- 1.5 identify the relationship between:
  - 1.5.1 wire speed and amperage
  - 1.5.2 welding voltage and arc length
- 1.6 describe the effects of:
  - 1.6.1 backhand or pull welding
  - 1.6.2 forehand or push welding
- 1.7 describe the effects of torch angle on:
  - 1.7.1 weld penetration
  - 1.7.2 weld appearance
- 1.8 describe corrective actions that can be taken to avoid:
  - 1.8.1 surface porosity
  - 1.8.2 subsurface porosity
  - 1.8.3 lack of fusion
  - 1.8.4 burn-through
  - 1.8.5 lack of penetration
  - 1.8.6 cold lapping

2. perform safe set-up, maintenance and troubleshooting procedures with FCAW equipment

- 2.1 perform maintenance required for wire drive systems and gun assemblies
- 2.2 diagnose and demonstrate corrective measures for malfunctioning FCAW equipment
- 2.3 for a given type of weld and/or weldment, select the appropriate:
  - 2.3.1 wire type, size and feed rate
  - 2.3.2 current
  - 2.3.3 shielding gas type and flow rate
- 2.4 select the proper fit-up for a given weld

3. demonstrate safe FCAW practices and perform groove welds on mild steel plate in the horizontal and vertical positions

- 3.1 describe safety issues related to:
  - 3.1.1 using personal protective equipment
  - 3.1.2 handling and storing consumables
  - 3.1.3 keeping the welding area free of hazards
  - 3.1.4 ensuring adequate ventilation
- 3.2 describe a safety plan in case of an accident
- 3.3 apply safe work practices and procedures to:
  - 3.3.1 select and use appropriate personal protective equipment
  - 3.3.2 maintain a clean and tidy workstation
  - 3.3.3 demonstrate safe tool/material handling and storage techniques
- 3.4 prepare and clean all surfaces to be welded
- 3.5 properly position metal for welding
- 3.6 demonstrate safe FCAW techniques and perform groove welds in the horizontal and vertical positions on mild steel plate
- 3.7 identify problems common to out-of-position welding
- 3.8 complete a visual inspection, i.e., non-destructive test, by observing and assessing:
  - 3.8.1 overall size, shape and appearance of beads
  - 3.8.2 plate penetration
  - 3.8.3 fusion
  - 3.8.4 degree of undercutting and overlapping
- 3.9 perform a destructive test, where appropriate

4. demonstrate basic competencies

- 4.1 demonstrate fundamental skills to:
  - 4.1.1 communicate
  - 4.1.2 manage information
  - 4.1.3 use numbers
  - 4.1.4 think and solve problems
- 4.2 demonstrate personal management skills to:
  - 4.2.1 demonstrate positive attitudes and behaviours
  - 4.2.2 be responsible
  - 4.2.3 be adaptable
  - 4.2.4 learn continuously
  - 4.2.5 work safely
- 4.3 demonstrate teamwork skills to:
  - 4.3.1 work with others
  - 4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

- 5.1 identify short-term and long-term goals
- 5.2 identify steps to achieve goals

COURSE FAB3050: ARC WELDING 3

Level: Advanced

Prerequisite: FAB2060: Arc Welding 2

Description: Students learn the role of codes and standards in the welding trade, as well as test welds and develop vertical position welding skills.

Parameters: Access to a welding facility, complete with Shielded Metal Arc Welding (SMAW) equipment and supplies, and to instruction from an individual with welding trade qualifications.

Outcomes: The student will:

1. **examine and maintain SMAW equipment and accessories**
   - 1.1 before beginning to weld:
     - 1.1.1 analyze the condition of cables and lugs
     - 1.1.2 ensure adequate air flow for proper cooling
     - 1.1.3 check the condition of all personal protective equipment
2. **read and interpret weld drawings and symbols**
   - 2.1 explain the purpose of welding:
     - 2.1.1 codes
     - 2.1.2 standards
     - 2.1.3 specifications
   - 2.2 identify agencies that establish codes and standards in Canada and the United States; e.g., Canadian Standards Association, American Welding Society, Canadian Welding Bureau, American Society of Mechanical Engineers
   - 2.3 explain the purpose of a welding symbol
   - 2.4 identify the basic data included in a welding symbol
   - 2.5 show how a welding symbol can be used to specify the:
     - 2.5.1 location of a weld
     - 2.5.2 type of weld
     - 2.5.3 welding process
     - 2.5.4 root opening
     - 2.5.5 contour
     - 2.5.6 degree of penetration
     - 2.5.7 type of electrode
   - 2.6 analyze common destructive and non-destructive testing methods
   - 2.7 use a welding symbol to determine the:
     - 2.7.1 location of a weld
     - 2.7.2 type of weld
     - 2.7.3 root opening
     - 2.7.4 type of electrode
3. **demonstrate advanced level SMAW competencies in the vertical position**
   - 3.1 use the appropriate equipment and supplies to make single and multiple pass fillet and groove welds in the vertical position
   - 3.2 perform one or more destructive and non-destructive tests on a weld sample

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:

- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:

- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:

- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals

5.2 identify steps to achieve goals

COURSE FAB3060: ARC WELDING 4

Level: Advanced

Prerequisite: FAB3050: Arc Welding 3

Description: Students apply and extend positional welding skills by using a variety of common electrodes and thickness of materials.

Parameters: Access to a welding facility, complete with Shielded Metal Arc Welding (SMAW) equipment and supplies, and to instruction from an individual with welding trade qualifications.

Outcomes: The student will:

1. **explain the effects heating and cooling have on a weld and weldment**
   - 1.1 describe the effect of single and multiple pass welds on the base metal and previously deposited filler metal
   - 1.2 explain the effect cold working conditions might have on weld quality
   - 1.3 explain the need to preheat or postheat
   - 1.4 describe the factors to be considered when choosing an electrode including:
     - 1.4.1 static and dynamic loading
     - 1.4.2 weld position
     - 1.4.3 materials to be welded
     - 1.4.4 current supply
     - 1.4.5 ease of use
     - 1.4.6 joint design and alignment
     - 1.4.7 rate of deposit
     - 1.4.8 depth of penetration
     - 1.4.9 weld finish
2. **demonstrate advanced level SMAW competencies in the flat, horizontal and vertical positions**
   - 2.1 describe the properties and uses of the following electrodes:
     - 2.1.1 E6010 and E6011
     - 2.1.2 E7014, E7018 and E7024
   - 2.2 select the appropriate electrode for a given application
   - 2.3 prepare the surfaces for welding
   - 2.4 correctly position the weld
   - 2.5 adjust the equipment to coincide with the type of electrode, weld and metal thickness
   - 2.6 demonstrate first period arc welding skills in the flat, horizontal and vertical positions using a variety of weld types, joints, electrodes and thicknesses of mild steel
   - 2.7 prepare welds for testing
   - 2.8 perform a non-destructive and a destructive test, where appropriate
3. **demonstrate basic competencies**
   - 3.1 demonstrate fundamental skills to:
     - 3.1.1 communicate
     - 3.1.2 manage information
     - 3.1.3 use numbers
     - 3.1.4 think and solve problems

3.2 demonstrate personal management skills to:
    3.2.1 demonstrate positive attitudes and behaviours
    3.2.2 be responsible
    3.2.3 be adaptable
    3.2.4 learn continuously
    3.2.5 work safely
3.3 demonstrate teamwork skills to:
    3.3.1 work with others
    3.3.2 participate in projects and tasks

4. create a transitional strategy to accommodate personal changes and build personal values

4.1 identify short-term and long-term goals
4.2 identify steps to achieve goals

COURSE FAB3070: PIPE & TUBULAR WELDING

Level: Advanced

Prerequisite: FAB3170: Gas Metal Arc Welding 2

Description: Students develop specific skills related to pipe layout, preparation of pipe/tube joints and welding techniques.

Parameters: Access to a welding facility, complete with welding equipment and supplies, and to instruction from an individual with welding trade qualifications.

Supporting Courses: FAB2040: Thermal Cutting
FAB2060: Arc Welding 2
FAB3050: Arc Welding 3

Outcomes: The student will:

1. **take preventive measures to avoid accident and personal injury to self and others by identifying health and safety hazards associated with pipe and enclosed vessel welding**
   - 1.1 identify the standards of certification required for welding:
     - 1.1.1 low pressure water lines or light structural application
     - 1.1.2 medium pressure residential gas lines
     - 1.1.3 high pressure gas lines and motorcycle and aircraft frames
   - 1.2 identify the precautions that must be taken prior to cutting or welding pipe or other enclosed vessels
   - 1.3 review a safety plan in case of an accident
2. **describe the advances made in pipe welding and identify common types of joints and welding procedures**
   - 2.1 list the advantages of welding over other forms of joining pipe related to:
     - 2.1.1 strength
     - 2.1.2 required maintenance
     - 2.1.3 flow of liquids and gases
     - 2.1.4 weight of joint
3. **demonstrate basic pipe/tube preparation and welding competencies**
   - 3.1 calculate the cut angle for a butt joint in relation to the wall thickness and intended application
   - 3.2 prepare a template for one or more of the following joints:
     - 3.2.1 90° two-piece turn
     - 3.2.2 full T-joint
     - 3.2.3 full lateral joint
     - 3.2.4 butt joint
   - 3.3 perform a V-groove weld using roll and position pipe welding techniques
   - 3.4 prepare and perform a:
     - 3.4.1 full T-joint
     - 3.4.2 full lateral joint tube and pipe weld
   - 3.5 apply suitable destructive and non-destructive tests to ensure weld quality

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals

5.2 identify steps to achieve goals

COURSE FAB3080: AUTOMATED WELDING

Level: Advanced

Prerequisite: FAB3170: Gas Metal Arc Welding 2

Description: Students investigate and describe the operation of various manual, semi-automated and automated welding processes and systems used in fabrication industries.

Parameters: Access to a welding facility, complete with welding equipment and supplies, and to instruction from an individual with welding trade qualifications.

Supporting Courses: FAB2030: Oxyfuel Welding
FAB2040: Thermal Cutting
FAB2060: Arc Welding 2

Outcomes: The student will:

1. **explain how manual, semi-automated and automated welding processes differ from one another**
   - 1.1 explain the difference between manual, semi-automated and automated cutting and welding processes:
   - 1.2 research the use of robots in welding to determine their advantages and disadvantages
   - 1.3 identify the main types of robots and describe their work envelope
   - 1.4 identify the main parts of a robot and the components of a robotic welding system
2. **apply knowledge of advanced welding processes to demonstrate/simulate an automated welding system**
   - 2.1 identify the hazards associated with specific machine and automated processes
   - 2.2 describe methods that are commonly used to protect an individual from injury by an automated system such as a robot
   - 2.3 describe a safety plan in case of an accident
   - 2.4 describe the specialized welding techniques that are suitable for semi-automated processes; e.g., resistance welding, Gas Metal Arc Welding (GMAW), Gas Tungsten Arc Welding (GTAW), plasma arc cutting, laser beam welding and cutting
   - 2.5 describe the use of a teach pendant in programming a robot to perform the designated task
   - 2.6 demonstrate or simulate a viable production system using semi- and/or fully automated processes
3. **demonstrate basic competencies**
   - 3.1 demonstrate fundamental skills to:
     - 3.1.1 communicate
     - 3.1.2 manage information
     - 3.1.3 use numbers
     - 3.1.4 think and solve problems

3.2 demonstrate personal management skills to:
    3.2.1 demonstrate positive attitudes and behaviours
    3.2.2 be responsible
    3.2.3 be adaptable
    3.2.4 learn continuously
    3.2.5 work safely
3.3 demonstrate teamwork skills to:
    3.3.1 work with others
    3.3.2 participate in projects and tasks

4. create a transitional strategy to accommodate personal changes and build personal values

4.1 identify short-term and long-term goals
4.2 identify steps to achieve goals

COURSE FAB3090: SHEET FABRICATION 4

Level: Advanced

Prerequisite: FAB2100: Sheet Fabrication 3

Description: Students develop specialized skills in cylindrical and conical pattern development and seam construction of ferrous and non-ferrous sheet metals.

Parameters: Access to a fabrication facility, complete with sheet metal shearing, forming, fastening and layout tools, and to instruction from an individual with specialized training in sheet metal practices.

Outcomes: The student will:

1. describe the procedures that are used to lay out a typical cylindrical and conical shape
- 1.1 research the properties of and applications of the following sheet materials:
  - 1.1.1 aluminum
  - 1.1.2 copper
  - 1.1.3 brass
  - 1.1.4 galvanized steel
  - 1.1.5 mild steel
  - 1.1.6 stainless steel
  - 1.1.7 tin plate
- 1.2 describe which materials are most malleable
- 1.3 describe the techniques that are used to form sheet stock
- 1.4 explain when single, double, grooved and wired seams are used in conjunction with cylindrical and conical fabrication
- 1.5 identify and describe the use of the following solder coppers:
  - 1.5.1 square point
  - 1.5.2 bottoming
  - 1.5.3 roofing

2. demonstrate parallel and radial line pattern making skills
- 2.1 describe the type of pattern development that is used to lay out a:
  - 2.1.1 cylinder
  - 2.1.2 cone
  - 2.1.3 rectangle to round
- 2.2 create the necessary pattern development, using a computer or conventional means

3. perform advanced cylindrical and conical sheet stock fabrication skills and processes
- 3.1 use a micrometer, calliper or sheet gauge to measure the thickness of a piece of sheet stock
- 3.2 calculate the inside, outside and mean diameter of a cylindrical component
- 3.3 identify the correct formula to calculate the allowances for seams and edges
- 3.4 select a product that incorporates:
  - 3.4.1 cylindrical and conical shapes
  - 3.4.2 grooved and double seams
  - 3.4.3 solder joints and finished edges
- 3.5 select the appropriate material for a given product and finish

3.6 use the appropriate tools, materials and processes to:
    3.6.1 cut and bend sheet stock
    3.6.2 raise and finish a surface
    3.6.3 locate and make joints watertight
3.7 wear personal protective clothing and equipment
3.8 show that tools are kept in working order
3.9 handle, store and discard metal off-cuts in a correct manner

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

COURSE FAB3110: SHEET FABRICATION 5

Level: Advanced

Prerequisite: FAB2100: Sheet Fabrication 3

Description: Students apply and develop specialized skills in duct component pattern making and fabrication techniques.

Parameters: Access to a fabrication facility, complete with sheet metal shearing, forming, fastening and layout tools, and to instruction from an individual with specialized training in sheet metal practices.

Supporting Course: FAB3090: Sheet Fabrication 4

Outcomes: The student will:

1. **identify common duct components and applications**
   - 1.1 prepare a list of duct system applications
   - 1.2 list and state the purpose of the following components used in a duct system:
     - 1.2.1 radius elbow
     - 1.2.2 riser
     - 1.2.3 offset
     - 1.2.4 branch tee
     - 1.2.5 take-off
   - 1.3 describe how air volume and pressures are measured
   - 1.4 analyze the effect of component resistance on static and velocity air pressures in a ducting system
2. **demonstrate the principle of triangulation to create a transition pattern**
   - 2.1 differentiate among the use of parallel line, radial line and triangulation in pattern development
   - 2.2 use triangulation to develop a pattern for an object whose sides are not parallel
3. **apply pattern making and sheet metal fabrication skills to create a duct component**
   - 3.1 list and describe the use and construction of the following joints:
     - 3.1.1 S and drive
     - 3.1.2 T-lock
     - 3.1.3 hammerlock
     - 3.1.4 government locks
   - 3.2 state the advantages and disadvantages of using each of the above systems
   - 3.3 calculate the material allowance for:
     - 3.3.1 S and drive
     - 3.3.2 T-lock
     - 3.3.3 hammerlock
   - 3.4 use the appropriate tools, materials and processes to fabricate specific components in a ducting system

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals

5.2 identify steps to achieve goals

COURSE FAB3120: FOUNDRY – CORE MOULDING

Level: Advanced

Prerequisite: FAB1120: Foundry – One-piece Pattern

Description: Students investigate and apply advanced foundry processes to produce a hollow casting, using a sand and core mould.

Parameters: Access to a fabrication facility, complete with foundry equipment and supplies, and to instruction from an individual with specialized training in foundry practices.

Supporting Course: FAB2120: Foundry – Split Pattern

Outcomes: The student will:

1. **list and describe common core materials and production processes**
   - 1.1 explain the purpose of a core and provide examples of products that require their use in casting
   - 1.2 describe the variables and characteristics of a good core mix
   - 1.3 identify common shapes and methods of producing and drying a core
   - 1.4 for a given casting, identify the appropriate core shape placement technique, core mix and reinforcement techniques
   - 1.5 prepare a sketch showing the location of:
     - 1.5.1 parting line and type of mould
     - 1.5.2 core and core prints
     - 1.5.3 venting, gating and pouring system for a given casting
2. **demonstrate advanced sand casting and coring skills and techniques**
   - 2.1 identify common binders that can be used with core sand; e.g.: sodium silicate and carbon dioxide, linseed oil, wheat flour and molasses, and other commercially prepared products
   - 2.2 describe safety concerns related to:
     - 2.2.1 personal protective equipment
     - 2.2.2 mould construction
     - 2.2.3 foundry furnace start-up and shut-down procedures
     - 2.2.4 heating and pouring procedures
     - 2.2.5 cleaning and finishing castings
   - 2.3 describe a safety plan in case of an accident
   - 2.4 create a casting using common pattern making, coring and pouring techniques
   - 2.5 clean and finish the casting according to specifications
   - 2.6 analyze the overall size, shape and structural soundness of the product
3. **demonstrate basic competencies**
   - 3.1 demonstrate fundamental skills to:
     - 3.1.1 communicate
     - 3.1.2 manage information
     - 3.1.3 use numbers
     - 3.1.4 think and solve problems

3.2 demonstrate personal management skills to:
    3.2.1 demonstrate positive attitudes and behaviours
    3.2.2 be responsible
    3.2.3 be adaptable
    3.2.4 learn continuously
    3.2.5 work safely
3.3 demonstrate teamwork skills to:
    3.3.1 work with others
    3.3.2 participate in projects and tasks

4. create a transitional strategy to accommodate personal changes and build personal values

4.1 identify short-term and long-term goals
4.2 identify steps to achieve goals

COURSE FAB3130: PRECISION TURNING 2

Level: Advanced

Prerequisite: FAB2130: Precision Turning 1

Description: Students develop specialized lathe skills for thread cutting and taper turning techniques.

Parameters: Access to a fabrication facility, complete with a metal lathe and accessories, and to instruction from an individual with specialized training in metal lathe practices.

Outcomes: The student will:

1. **demonstrate print reading and job sequencing competencies**
   - 1.1 use a machine drawing to identify the:
     - 1.1.1 overall size and shape of a machine part
     - 1.1.2 thread type, size, tolerance and fit
     - 1.1.3 taper type, size and fit
     - 1.1.4 materials
   - 1.2 research hole-machining operation procedures
   - 1.3 create a systematic sequence of operations to machine a given part
   - 1.4 calculate the appropriate cutting speeds, feed rates and depth of cuts for a given operation
2. **perform safe taper turning and thread cutting set-up procedures**
   - 2.1 describe the hazards associated with metal lathes and metal cutting operations
   - 2.2 list and describe common lathe accessories such as drill chuck, taper attachment and thread dial
   - 2.3 list and describe common types of tapers including:
     - 2.3.1 Morse taper
     - 2.3.2 standard milling machine taper
     - 2.3.3 taper pins
   - 2.4 identify the parts of a thread
   - 2.5 describe a safety plan in case of an accident
3. **perform taper turning and thread cutting operations**
   - 3.1 observe methods of cutting a taper by using the:
     - 3.1.1 compound rest
     - 3.1.2 tailstock offset
     - 3.1.3 taper attachment methods
   - 3.2 identify the factors that determine the most efficient method of cutting a taper including the:
     - 3.2.1 length and angle of taper
     - 3.2.2 quality of finish
     - 3.2.3 number of duplicates
   - 3.3 describe the principal features of a:
     - 3.3.1 Unified National Coarse
     - 3.3.2 Unified National Fine
     - 3.3.3 tapered pipe thread
     - 3.3.4 ISO metric thread
   - 3.4 describe the set-up procedures to cut internal and external left- and right-handed threads
   - 3.5 describe the classes of fit associated with the Unified thread system

3.6 demonstrate skills in:
    3.6.1 hole-machining operations
    3.6.2 inside and outside taper turning
    3.6.3 cutting inside and outside threads

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

COURSE FAB3140: PRECISION MILLING 2

Level: Advanced

Prerequisite: FAB2140: Precision Milling 1

Description: Students develop specialized skills to use vertical and/or horizontal milling machines.

Parameters: Access to a fabrication facility, complete with a horizontal mill and accessories, and to instruction from an individual with specialized training in advanced level machining practices.

Outcomes: The student will:

1. **demonstrate print reading and job sequencing competencies**
   - 1.1 use a machine drawing to determine:
     - 1.1.1 the overall size and shape of a machine part
     - 1.1.2 specific types and sizes of grooves/slots, keyways and gear teeth
   - 1.2 list and describe the machining operations for a given machine part and/or feature in a logical sequence
   - 1.3 identify the appropriate type of milling machine and cutters for each operation
   - 1.4 select workpiece holding device
   - 1.5 calculate the appropriate cutting speeds, feed rates and recommended depths of cut for a given operation
   - 1.6 select appropriate cutting fluids
2. **perform safe vertical and/or horizontal mill set-up procedures**
   - 2.1 describe the hazards associated with manual milling operations
   - 2.2 describe a safety plan in case of an accident
   - 2.3 describe safe set-up procedures to mill grooves, keyways and gear teeth
   - 2.4 identify the conditions that produce cutter failure including:
     - 2.4.1 excessive heat
     - 2.4.2 clogging
     - 2.4.3 work hardening
   - 2.5 identify common machine parts that require indexing
3. **perform groove keyway and gear cutting operations**
   - 3.1 identify and describe the types of cutters that are available for cutting common grooves/slots, keyways and gear teeth
   - 3.2 explain the difference between a high speed steel and a tungsten carbide cutter
   - 3.3 describe how an indexing head is used when cutting a spur gear
   - 3.4 demonstrate skills in milling:
     - 3.4.1 grooves/slots
     - 3.4.2 keyways
     - 3.4.3 gear teeth

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:

- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:

- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:

- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals

5.2 identify steps to achieve goals

COURSE FAB3150: CNC MILLING

Level: Advanced

Prerequisite: FAB1130: Principles of Machining

Description: Students develop skills in computer numerical control (CNC) programming to manufacture a three-dimensional product.

Parameters: Access to a CNC milling centre and to instruction from an individual with specialized training in CNC millwork.

Supporting Course: FAB2150: CNC Turning

Outcomes: The student will:

1. **demonstrate three-dimensional CNC programming skills**
   - 1.1 identify the relationship of the *x*, *y* and *z* axis on a vertical milling machine
   - 1.2 determine how to program a CNC mill using absolute coordinates
   - 1.3 describe the types of canned cycles used in machining operations
   - 1.4 identify when to use canned cycles to improve efficiency
   - 1.5 list the information required to calculate and format a canned cycle
   - 1.6 prepare a program from a print using absolute coordinates and/or produce a computer assisted drafting (CAD) design
2. **apply CNC programming and operating skills to manufacture a milled part**
   - 2.1 after observing the operation of a CNC mill, describe how the cutting speeds, feed rates and depth of cuts are controlled, and how the cutting tools and different sizes and shapes of workpieces are mounted
   - 2.2 identify the milling capabilities of a given machine; e.g., size of cutters, size and types of materials
   - 2.3 describe the safety features that are built into the CNC equipment
   - 2.4 describe the:
     - 2.4.1 appropriate use of personal protective equipment
     - 2.4.2 importance of keeping all covers and guards in place and following the manufacturer's recommendations
     - 2.4.3 need to keep the work area clean and free of personal hazards
   - 2.5 describe a safety plan in case of an accident
   - 2.6 load the program or convert a CAD file
   - 2.7 mount and secure the workpiece
   - 2.8 identify reference and clearance points
   - 2.9 mount and set cutting tool(s)
   - 2.10 carry out a test run
   - 2.11 manufacture the part
   - 2.12 inspect the part to see that it meets the print dimensions, tolerances and specifications

3. demonstrate basic competencies

- 3.1 demonstrate fundamental skills to:
  - 3.1.1 communicate
  - 3.1.2 manage information
  - 3.1.3 use numbers
  - 3.1.4 think and solve problems
- 3.2 demonstrate personal management skills to:
  - 3.2.1 demonstrate positive attitudes and behaviours
  - 3.2.2 be responsible
  - 3.2.3 be adaptable
  - 3.2.4 learn continuously
  - 3.2.5 work safely
- 3.3 demonstrate teamwork skills to:
  - 3.3.1 work with others
  - 3.3.2 participate in projects and tasks

4. create a transitional strategy to accommodate personal changes and build personal values

- 4.1 identify short-term and long-term goals
- 4.2 identify steps to achieve goals

COURSE FAB3160: PREFABRICATION PRINCIPLES

Level: Advanced

Prerequisite: FAB2160: Custom Fabrication

Description: Students work in a cooperative learning environment to plan and construct a prefabricated product/structure to meet the specific needs of a client.

Parameters: Access to fabrication facilities and equipment, and to instruction from an individual with journeyperson qualifications if students are involved in customer work related to welding or other trade-related activities.

Outcomes: The student will:

1. **perform basic shop drawing take-off skills**
   - 1.1 explain procedures that are used to create a cutting list from a shop drawing
   - 1.2 create a cutting list from a shop drawing
2. **demonstrate advanced level resource management skills**
   - 2.1 locate appropriate materials and supplies
   - 2.2 identify specialized equipment and processes that will be required
   - 2.3 prepare a production flowchart
   - 2.4 show how to meet with the customer to determine the product/structure specifications
   - 2.5 create a suitable prefabricated design, time line and budget
   - 2.6 show how to apprise the customer of any need to make changes
3. **demonstrate appropriate prefabrication skills and practices**
   - 3.1 cite examples of products that are built from prefabricated parts
   - 3.2 describe the advantages and disadvantages of prefabricating a component
   - 3.3 identify specific design considerations that must be adhered to when using prefabricated components
   - 3.4 describe safe rigging procedures that are used to move materials and components
   - 3.5 prepare the required templates, jigs and fixtures
   - 3.6 assign responsibilities to:
     - 3.6.1 break out materials according to a prearranged plan
     - 3.6.2 process materials with a minimum number of set-ups
     - 3.6.3 assemble, finish and prepare the product for delivery
   - 3.7 explain the need to:
     - 3.7.1 identify group and individual responsibilities
     - 3.7.2 identify and capitalize on individual strengths
   - 3.8 help install/assemble the product, if contracted
   - 3.9 participate in group and self-evaluation processes
   - 3.10 demonstrate strategies for positive criticism
   - 3.11 complete a customer satisfaction follow-up survey
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

COURSE FAB3170: GAS METAL ARC WELDING 2

Level: Advanced

Prerequisite: FAB2070: Gas Metal Arc Welding 1

Description: Students develop skills to evaluate and improve the quality of gas metal arc weldings, and they extend their Gas Metal Arc Welding (GMAW) skills by performing horizontal and vertical groove welds.

Parameters: Access to a fabrication work centre, complete with GMAW equipment and supplies, and to instruction from an individual with welding trade qualifications.

Outcomes: The student will:

1. **identify variables that affect the quality of gas metal arc welds and identify strategies to evaluate and improve weld quality**
   - 1.1 identify the variables that can directly affect weld quality; e.g., the welding current and voltage, type of shielding gas/flux, diameter and type of filler metal, type and condition of equipment, welding technique
   - 1.2 select the appropriate shielding gas mixture based on:
     - 1.2.1 mode of metal transfer
     - 1.2.2 base metal type and thickness
     - 1.2.3 joint design
     - 1.2.4 filler material
     - 1.2.5 desired weld quality
   - 1.3 describe how to select the type and size of filler metal
   - 1.4 explain how to avoid contamination of filler materials
   - 1.5 identify the relationship between:
     - 1.5.1 wire speed and amperage
     - 1.5.2 welding voltage and arc length
   - 1.6 describe the effects of:
     - 1.6.1 backhand or pull welding
     - 1.6.2 forehand or push welding
   - 1.7 describe the effects of torch angle on:
     - 1.7.1 weld penetration
     - 1.7.2 weld appearance
   - 1.8 complete a visual inspection, i.e., non-destructive test, by observing and assessing:
     - 1.8.1 overall size, shape and appearance of beads
     - 1.8.2 plate penetration
     - 1.8.3 fusion
     - 1.8.4 degree of undercutting and overlapping
   - 1.9 perform a destructive test, where appropriate
2. **perform safe set-up, maintenance and troubleshooting procedures with GMAW equipment**
   - 2.1 apply safe work practices and procedures to:
     - 2.1.1 select and use appropriate personal protective equipment
     - 2.1.2 maintain a clean and tidy work station
     - 2.1.3 demonstrate safe tool/material handling and storage techniques

2.2 for a given type of weld and/or weldment, select the appropriate:
    2.2.1 wire type, size and feed rate
    2.2.2 current
    2.2.3 shielding gas type and flow rate
2.3 select the proper fit-up for a given weld
2.4 describe corrective actions that can be taken to avoid:
    2.4.1 surface porosity
    2.4.2 subsurface porosity
    2.4.3 lack of fusion
    2.4.4 burn-through
    2.4.5 lack of penetration
    2.4.6 cold lapping
2.5 identify problems common to out-of-position welding
2.6 perform maintenance required for wire drive systems and gun assemblies
2.7 diagnose and demonstrate corrective measures for malfunctioning GMAW equipment

3. demonstrate safe GMAW practices to perform groove welds on mild steel plate in the horizontal and vertical positions

3.1 describe safety issues related to:
    3.1.1 using personal protective equipment
    3.1.2 handling and storing consumables
    3.1.3 keeping the welding area free of hazards
    3.1.4 ensuring adequate ventilation
3.2 describe a safety plan in case of an accident
3.3 prepare and clean all surfaces to be welded
3.4 properly position metal for welding
3.5 demonstrate safe GMAW techniques and perform groove welds in the horizontal and vertical positions on mild steel plate

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

COURSE FAB3910: FAB PROJECT D

Level: Advanced

Prerequisite: None

Description: Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

Parameters: Advanced project courses must connect with a minimum of two CTS courses, one of which must be at the advanced level and be in the same occupational area as the project course. The other CTS course(s) must be at least at the intermediate level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. **identify the connection between this project course and two or more CTS courses**
   - 1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
   - 1.2 explain how these outcomes are being connected to the project and/or performance deliverables
2. **propose the project and/or performance**
   - 2.1 identify the project and/or performance by:
     - 2.1.1 preparing a plan
     - 2.1.2 clarifying the purposes
     - 2.1.3 defining the deliverables
     - 2.1.4 specifying time lines
     - 2.1.5 explaining terminology, tools and processes
     - 2.1.6 defining resources; e.g., materials, costs, staffing
   - 2.2 identify and comply with all related health and safety standards
   - 2.3 define assessment standards (indicators for success)
   - 2.4 present the proposal and obtain necessary approvals

The student will:

3. **meet goals as defined within the plan**
   - 3.1 complete the project and/or performance as outlined
   - 3.2 monitor the project and/or performance and make necessary adjustments
   - 3.3 present the project and/or performance, indicating the:
     - 3.3.1 outcomes attained
     - 3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

COURSE FAB3920: FAB PROJECT E

Level: Advanced

Prerequisite: None

Description: Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

Parameters: Advanced project courses must connect with a minimum of two CTS courses, one of which must be at the advanced level and be in the same occupational area as the project course. The other CTS course(s) must be at least at the intermediate level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. **identify the connection between this project course and two or more CTS courses**
   - 1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
   - 1.2 explain how these outcomes are being connected to the project and/or performance deliverables
2. **propose the project and/or performance**
   - 2.1 identify the project and/or performance by:
     - 2.1.1 preparing a plan
     - 2.1.2 clarifying the purposes
     - 2.1.3 defining the deliverables
     - 2.1.4 specifying time lines
     - 2.1.5 explaining terminology, tools and processes
     - 2.1.6 defining resources; e.g., materials, costs, staffing
   - 2.2 identify and comply with all related health and safety standards
   - 2.3 define assessment standards (indicators for success)
   - 2.4 present the proposal and obtain necessary approvals

The student will:

3. **meet goals as defined within the plan**
   - 3.1 complete the project and/or performance as outlined
   - 3.2 monitor the project and/or performance and make necessary adjustments
   - 3.3 present the project and/or performance, indicating the:
     - 3.3.1 outcomes attained
     - 3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

COURSE FAB3950: FAB ADVANCED PRACTICUM

Level: Advanced

Prerequisite: None

Description: Students apply prior learning and demonstrate the attitudes, skills and knowledge required by an external organization to achieve a credential/credentials or an articulation.

Parameters: This practicum course, which may be delivered on- or off-campus, should be accessed only by students continuing to work toward attaining a recognized credential/credentials or an articulation offered by an external organization. This course must be connected to at least one CTS course from the same occupational area and cannot be used in conjunction with any introductory (1XXX) level course. A practicum course cannot be delivered as a stand-alone course, cannot be combined with a CTS project course and cannot be used in conjunction with the Registered Apprenticeship Program or the Green Certificate Program.

Outcomes: The student will:

1. **perform assigned tasks and responsibilities, as required by the organization granting the credential(s) or articulation**
   - 1.1 identify regulations and regulatory bodies related to the credential(s) or articulation
   - 1.2 describe personal roles and responsibilities, including:
     - 1.2.1 key responsibilities
     - 1.2.2 support functions/responsibilities/expectations
     - 1.2.3 code of ethics and/or conduct
   - 1.3 describe personal work responsibilities and categorize them as:
     - 1.3.1 routine tasks; e.g., daily, weekly, monthly, yearly
     - 1.3.2 non-routine tasks; e.g., emergencies
     - 1.3.3 tasks requiring personal judgement
     - 1.3.4 tasks requiring approval of a supervisor
   - 1.4 demonstrate basic employability skills and perform assigned tasks and responsibilities related to the credential(s) or articulation
2. **analyze personal performance in relation to established standards**
   - 2.1 evaluate application of the attitudes, skills and knowledge developed in related CTS courses
   - 2.2 evaluate standards of performance in terms of:
     - 2.2.1 quality of work
     - 2.2.2 quantity of work
   - 2.3 evaluate adherence to workplace legislation related to health and safety
   - 2.4 evaluate the performance requirements of an individual who is trained, experienced and employed in a related occupation in terms of:
     - 2.4.1 training and certification
     - 2.4.2 interpersonal skills
     - 2.4.3 technical skills
     - 2.4.4 ethics

3. demonstrate basic competencies

3.1 demonstrate fundamental skills to:

- 3.1.1 communicate
- 3.1.2 manage information
- 3.1.3 use numbers
- 3.1.4 think and solve problems

3.2 demonstrate personal management skills to:

- 3.2.1 demonstrate positive attitudes and behaviours
- 3.2.2 be responsible
- 3.2.3 be adaptable
- 3.2.4 learn continuously
- 3.2.5 work safely

3.3 demonstrate teamwork skills to:

- 3.3.1 work with others
- 3.3.2 participate in projects and tasks

4. create a transitional strategy to accommodate personal changes and build personal values

4.1 identify short-term and long-term goals

4.2 identify steps to achieve goals