

## **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**

<b>Level:</b>	Intermediate
<b>Prerequisite:</b>	FAB1040: Oxyacetylene Welding
<b>Description:</b>	Students develop basic skills to use, safely and efficiently, thermal cutting equipment and supplies.
<b>Parameters:</b>	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.
<b>Outcomes:</b>	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