

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 a 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