

COURSE CURRICULUM AND ASSESSMENT STANDARDS:

SECTION E: INTERMEDIATE LEVEL

The following pages define the curriculum and assessment standards for the intermediate level of Fabrication Studies.

Intermediate level courses help students build on the competencies developed at the introductory level and focus on developing more complex competencies. They provide a broader perspective, helping students recognize the wide range of related career opportunities available within the strand.

Course FAB2010: Structural Engineering	E.3
Course FAB2020: Print Reading	E.7
Course FAB2030: Oxyfuel Welding	E.11
Course FAB2040: Thermal Cutting	E.15
Course FAB2050: Arc Welding 1	E.19
Course FAB2060: Arc Welding 2	E.23
Course FAB2070: Gas Metal Arc Welding 1	E.27
Course FAB2090: Sheet Fabrication 2 (Machine Processes)	E.31
Course FAB2100: Sheet Fabrication 3 (Parallel Line)	E.35
Course FAB2110: Forging Fundamentals	E.39
Course FAB2120: Foundry 2 (Split Pattern)	E.43
Course FAB2130: Precision Turning 1	E.47
Course FAB2140: Precision Milling 1	E.51
Course FAB2150: CNC Turning (Computer Numerical Control)	E.55
Course FAB2160: Custom Fabrication	E.59
Course FAB2170: Pipe Fitting	E.63
Course FAB2048: Flux Core Arc Welding 1	E.67

COURSE FAB2010: STRUCTURAL ENGINEERING**Level:** Intermediate**Theme:** Materials and Structures**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**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> list and describe the principal characteristics of all structures identify strategies to improve the efficiency of a structure apply principles of structural design to fabrication and construction activities 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> a written or oral report that provides evidence that: <ul style="list-style-type: none"> all structures found in nature or in the constructed world share common elements and principles of construction structural elements provide both shape and support to the structure forces are dispersed throughout the structure forces must be kept in balance to keep a structure from failing complete analysis of a given structure to show how: <ul style="list-style-type: none"> strength can be improved weight can be reduced building costs can be reduced safe fabrication/construction of a structure or component that meets overall design requirements in relation to strength, appearance and cost. 	20
	<p><i>Assessment Tool</i> <i>Presentations/Reports: Building Structures, FAB2010-1</i></p>	20
	<p><i>Standard</i> <i>Assessment will be based on the strength to weight ratio, appearance, cost of materials and ease of construction</i> <i>Performance rating of 2 for each applicable task</i></p>	60

COURSE FAB2010: STRUCTURAL ENGINEERING (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>Integrated throughout</p>

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> Characteristics of Structure Types of Structures Structural Materials Structural Elements 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> through the analysis of natural and fabricated (synthetic) forms, explain how: <ul style="list-style-type: none"> structural elements provide both shape and support structures are built to withstand forces of nature, applied loads and the weights of the structural components loads applied to a structure generate forces that must be kept in balance most structures are built with a margin of safety identify from natural and synthetic structures examples of: <ul style="list-style-type: none"> frame shell non-rigid structures identify natural and synthetic structural materials that have good: <ul style="list-style-type: none"> tensile strength compressive strength elasticity list typical structural components that are used as: <ul style="list-style-type: none"> linear elements, such as a beam vertical elements, such as a column non-rigid elements, such as a cable 	<p>Compare the similarities of structure found in nature to those constructed by humans.</p> <p>Explain why it is important to understand the properties of a material before it is placed in a structure.</p>

COURSE FAB2010: STRUCTURAL ENGINEERING (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none"> • Structural Elements (continued) • Beam and Truss Construction 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • explain the purpose of rigid and non-rigid materials that are used between linear and vertical elements; e.g., plywood and canvas • describe the advantages and disadvantages of non-rigid structures • show how triangulation is used to stabilize a truss and rectangular frame • demonstrate the effects of moving a load close to or away from the neutral axis of a beam • compare the connecting limits of adhesive and cohesive materials and rigid fasteners. 	
<p>Planning and Management</p> <ul style="list-style-type: none"> • Structural Loading • Design Application 	<ul style="list-style-type: none"> • describe the effects of the following forces on a simple rigid structure: <ul style="list-style-type: none"> – compression – tension – shear – bending – twisting • show how internal forces are created to balance external loads • demonstrate the effects one element has on another when it fails • analyze an existing structure and redesign it to increase its efficiency by: <ul style="list-style-type: none"> – reducing weight yet maintaining strength – enhancing its durability and usefulness – reducing material and construction costs. 	
<p>Implementation</p> <ul style="list-style-type: none"> • Construction 	<ul style="list-style-type: none"> • fabricate a structure or component using common materials, tools and contemporary design principles. 	

COURSE FAB2010: STRUCTURAL ENGINEERING (continued)

Concept	Specific Outcomes	Notes
<p>Assessment</p> <ul style="list-style-type: none"> • Quality Control and Efficiency • Career Preparation 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • analyze and test a structure or component to determine its: <ul style="list-style-type: none"> – strength to weight ratio – cost efficiency – service and construction limitations • prepare a record of completed activities within a portfolio. 	<p>Simple testing devices can be constructed to determine the strength-to-weight ratio.</p>

COURSE FAB2020: PRINT READING**Level:** Intermediate**Theme:** Materials and Structures**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.**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • identify and describe the principal components of a print • demonstrate basic print reading skills <ul style="list-style-type: none"> • demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • a written or oral response that identifies the correct use of lines, symbols, dimensions and notes on a working drawing • the accurate identification of materials, sizes and fabrication process given a working drawing of a machine part, weld, structure or system. <p><i>Assessment Tool</i> <i>Response Assessment: Print Reading Applications, FAB2020-1</i></p> <p><i>Standard</i> <i>Response rating of 2</i></p> <ul style="list-style-type: none"> • observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>20</p> <p>80</p> <p>Integrated throughout</p>

COURSE FAB2020: PRINT READING (continued)

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> • Types of Drawings • Lines • Dimensions • Symbols • Fasteners 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe the types of drawings that are used to visualize an object pictorially and orthographically • identify and describe the types of lines commonly found on a drawing; e.g.: <ul style="list-style-type: none"> – object – hidden – centre line – dimension • research dimensioning systems used to identify: <ul style="list-style-type: none"> – linear dimensions – angular dimensions – limits, fits and tolerance • identify the symbols used to describe: <ul style="list-style-type: none"> – types of materials – structural shapes – seams and joints – fabrication processes • read and interpret symbols denoting weld types and structural shapes • identify the types of threaded fasteners and methods of representation; e.g.: <ul style="list-style-type: none"> – detailed – schematic • identify the types of non-threaded fasteners and methods of representation; e.g.: <ul style="list-style-type: none"> – detailed – symbols. 	<p>This course can be taught independently or by integrating it with other courses in welding, sheet metal or machining.</p> <p>Examine symbols used on electrical, plumbing, heating, machining and welding drawings.</p>
<p>Planning and Management</p>	<ul style="list-style-type: none"> • explain how prints are used to create a: <ul style="list-style-type: none"> – bill of materials – cutting list – schedule of operations. 	

COURSE FAB2020: PRINT READING (continued)

Concept	Specific Outcomes	Notes
<p>Implementation</p> <ul style="list-style-type: none"> • Print Reading 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • match pictorial and orthographic drawings that have: <ul style="list-style-type: none"> – a surface parallel to the viewing plane – hidden edges or surfaces – inclined and oblique surfaces – curved surfaces and holes • read and interpret multiview prints to determine object sizes, shapes and fabrication specifications • read and interpret the size, type and location of threaded and non-threaded fasteners • prepare a list of materials and sequence of machine/tool operations from a given print. 	
<p>Assessment</p> <ul style="list-style-type: none"> • Quality Control • Career Preparation 	<ul style="list-style-type: none"> • outline the importance of accurate prints and print reading skills to ensure high standards of quality and productivity • prepare a record of completed activities within a portfolio. 	

COURSE FAB2030: OXYFUEL WELDING**Level:** Intermediate**Theme:** Fabrication Processes**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.**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • describe the essential differences between braze welding and fusion welding • demonstrate basic braze welding competencies 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • an oral or written response that outlines the essential differences between braze welding and fusion welding • completion of a series of braze weld applications in the flat and horizontal positions. <p><i>Assessment Tool</i> <i>Fabrication Process: Basic Oxyfuel Welding, FAB2030-1</i></p> <p><i>Standard</i> <i>Beads are to be slightly convex and of uniform width and height; ripples are to be evenly spaced and free of craters</i> <i>Performance rating of 2 for each applicable task</i></p>	<p>10</p> <p>30</p>

COURSE FAB2030: OXYFUEL WELDING (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • demonstrate basic oxyfuel weld (OFW) competencies in the flat, horizontal and vertical positions • demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • completion of light and heavy gauge fillet and square groove butt welds in the flat, horizontal and vertical positions. <p><i>Assessment Tool</i> <i>Fabrication Process: Basic Oxyfuel Welding, FAB2030-1</i> <i>Illustrative Example: Vertical Butt Joint Fusion Weld, FAB2030-2</i></p> <p><i>Standard</i> <i>Weld profile should be slightly convex and of uniform width and height; ripples are to be close, bullet shaped and free of voids, evidence of undercutting and overlapping. Good depth of penetration should be evident over the entire length of the weld</i> <i>Performance rating of 2 for each applicable task</i></p> <ul style="list-style-type: none"> • observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any Assessment Tools noted above</i></p>	<p>60</p> <p>Integrated throughout</p>

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> • Health and Safety 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe health and safety issues such as: <ul style="list-style-type: none"> – using the appropriate personal protective equipment and clothing – keeping the welding area free of combustible materials – insuring adequate ventilation particularly when braze welding – returning and storing all consumables as directed – locating appropriate fire extinguishers in the event of a fire 	

COURSE FAB2030: OXYFUEL WELDING (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none"> • Storage and Set Up of Oxygen and Fuel Cylinders • Oxyfuel Gases • Welding Principles 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe the appropriate moving, storing and set-up procedures • identify local codes and restrictions related to the use and storage of oxygen and acetylene cylinders • describe the alternative gases available for heating; their comparative temperatures and applications such as MAPP and propane • describe the differences between fusion welding and braze welding • list the advantages and disadvantages of braze welding. 	<p>Review WHMIS regulations regarding the safe storage and handling of oxyfuel cylinders.</p> <p>Explain the difference between cohesive and adhesive bonding.</p>
<p>Planning and Management</p>	<ul style="list-style-type: none"> • select the correct filler rod and tip size for a given application • set working gas pressures to match the tip size • describe the appropriate clearance allowed between parts of a braze weldment. 	<p>Review safe start-up and shut-down procedures.</p>
<p>Implementation</p> <ul style="list-style-type: none"> • Oxyfuel Welding 	<ul style="list-style-type: none"> • demonstrate basic skills in braze welding in the flat and horizontal positions • demonstrate basic fusion welding skills in the flat, vertical and horizontal positions. 	<p>Have students practise making a bead before attempting a braze weld.</p> <p>It is recommended that students practice flat butt joints before proceeding to the vertical and horizontal positions.</p>
<p>Assessment</p> <ul style="list-style-type: none"> • Quality Control • Career Information • Career Preparation 	<ul style="list-style-type: none"> • prepare a destructive and non-destructive weld assessment • research applications of oxyfuel welding • prepare a record of completed activities within a portfolio. 	

COURSE FAB2040: THERMAL CUTTING**Level:** Intermediate**Theme:** Fabrication Processes**Prerequisite:** FAB1040 Oxyacetylene Welding**Description:** Students develop basic skills to use, safely and efficiently, thermal cutting equipment and supplies.**Parameters:** Access to a fabrication work centre complete with thermal cutting equipment and to instruction from an individual with formal, specialized training in oxyfuel cutting practices.**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • identify health and safety hazards associated with thermal cutting, and take preventive measures to avoid accidents and personal injury to self and others • perform safe start-up and shut-down cutting procedures • demonstrate basic manual cutting operations 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • observed performance related to: <ul style="list-style-type: none"> – lab preparation – lab management – safe tool/material handling and storage 	10
	<ul style="list-style-type: none"> • demonstration of consistent safe start-up and shut-down procedures using oxyfuel, carbon arc and/or plasma arc equipment 	20
	<ul style="list-style-type: none"> • completion of uniform, straight, irregular and bevel cuts and pierced holes. <p><i>Assessment Tool</i> <i>Assessment Framework: Fabrication Process, FABPRS</i></p> <p><i>Standard</i> <i>Edges are to be square and drag lines are essentially vertical and not overly pronounced.</i> <i>There should not be evidence of gouging or excessive amounts of slag or dross</i> <i>Performance rating of 2 for each applicable task</i></p>	70

COURSE FAB2040: THERMAL CUTTING (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>Integrated throughout</p>

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> Health and Safety Thermal Cutting Characteristics of Ferrous and Nonferrous Metals Oxyfuel Cutting 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> identify the workplace labels and precautionary procedures when using: <ul style="list-style-type: none"> compressed gas flammable materials oxidizing materials electrical equipment review a safety plan in case of accident describe common metals that can be successfully cut using: <ul style="list-style-type: none"> oxyfuel air carbon arc shielded metal arc plasma arc processes describe the oxyfuel process in relation to: <ul style="list-style-type: none"> ignition temperature and identification slag and oxide removal identify the types of cutting fuels, their operating temperatures and efficiency ratios identify the parts of a cutting torch and their function describe the relationship between tip size, metal thickness and gas pressures 	<p>Explain why oxyfuel cutting is limited to cutting ferrous materials.</p>

COURSE FAB2040: THERMAL CUTTING (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none"> • Oxyfuel Cutting (continued) • Plasma Arc Cutting 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe the factors controlling tip selection; e.g.: <ul style="list-style-type: none"> – depth of cut – type of material – condition of metal – type and quality of cut • describe the correct way to start a cut and pierce a hole • describe the plasma arc process in relation to: <ul style="list-style-type: none"> – arc formation – cutting gas – cooling – dross formation • identify and describe the purpose of the parts of a plasma arc cutting system • describe the appropriate method to: <ul style="list-style-type: none"> – start an arc – set standoff distance – control the kerf • list the advantages of using a plasma arc cutting system. 	<p>Explain why the plasma arc process can be used for cutting both ferrous and nonferrous materials.</p> <p>In addition to plasma arc cutting, demonstrate the use of carbon arc gouging equipment.</p>
<p>Planning and Management</p> <ul style="list-style-type: none"> • Tool Selection and Adjustment • Worker Safety 	<ul style="list-style-type: none"> • select and adjust the appropriate equipment for a given cutting operation • describe correct start-up and shut-down procedures • locate the recommended fire extinguisher • locate and wear the appropriate personal protective equipment • locate and clear the workstation of all combustible materials. 	

COURSE FAB2040: THERMAL CUTTING (continued)

Concept	Specific Outcomes	Notes
<p>Implementation</p> <ul style="list-style-type: none"> • Oxyfuel • Plasma Arc • Carbon Arc Gouging 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • demonstrate the use of oxyfuel equipment to cut: <ul style="list-style-type: none"> – straight edges and bevels – curves – holes in mild steel plate • demonstrate the use of plasma arc to cut: <ul style="list-style-type: none"> – straight and curved cuts – holes in ferrous and non-ferrous metals • demonstrate the safe use of carbon arc gouging equipment. 	<p>Besides preparing materials for fabrication, metal cutting equipment is often used to create metal sculpture.</p>
<p>Assessment</p> <ul style="list-style-type: none"> • Quality Control • Career Preparation 	<ul style="list-style-type: none"> • 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 • prepare a record of completed activities within a portfolio. 	

COURSE FAB2050: ARC WELDING 1**Level:** Intermediate**Theme:** Fabrication Processes**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 shielded metal arc welding equipment and supplies and to instruction from an individual with formal, specialized training in arc welding practices.**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> identify the appropriate treatment for minor injuries associated with welding processes describe the visual characteristics of a desirable weld demonstrate basic SMAW competencies in the flat position 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> the proper identification of first-aid treatment for minor cuts, burns and bruises identification and description of the important visual characteristics of a desirable weld the completion of a series of stringer and/or weave beads in the flat position on a given weldment and two successive fillet and butt weld joints in the flat position. <p><i>Assessment Tool</i> <i>Fabrication Process: Basic Arc Welding, FAB2050-1</i> <i>Illustrative Example: Flat Lap Joint Fillet Weld, FAB2050-2</i></p> <p><i>Standard</i> <i>Weld profile should be slightly convex and of uniform width and height; ripples are to be close, bullet shaped and free of voids, slag inclusion, high spots and apparent restarts. Good plate penetration should exist over the entire length of the weld</i> <i>Performance rating of 2 for each applicable task</i></p>	<p>15</p> <p>10</p> <p>75</p>

COURSE FAB2050: ARC WELDING 1 (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>Integrated throughout</p>

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> First Aid Electrical Fundamentals Arc Welding Equipment 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> demonstrate and describe the procedures for administering first aid for minor cuts, burns and bruises explain the effects of arc flash and the suggested treatment describe the effects of inadequate ventilation and the suggested treatment demonstrate knowledge of the following electrical terms: <ul style="list-style-type: none"> – direct current – alternating current – voltage – amperage – resistance – polarity – open circuit voltage and arc voltage compare the operation and current output produced by a: <ul style="list-style-type: none"> – transformer – rectifier – generator explain the meaning of duty cycle 	<p>Students need to have a good understanding of electrical terms and principles for their own safety and appreciation of how arc welding equipment operates.</p> <p>Explain the difference between a constant current power supply used in SMAW and a constant voltage supply used on GMAW equipment.</p>

COURSE FAB2050: ARC WELDING 1 (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none"> • Welding Accessories 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe the construction and sizing of cables • compare the different types of electrode holders and maintenance requirements • identify the types and uses of cable lugs, quick connectors and work clamps. 	
<p>Planning and Management</p> <ul style="list-style-type: none"> • Technique <p>Equipment Set-up</p> <ul style="list-style-type: none"> • Weld Quality 	<ul style="list-style-type: none"> • describe and demonstrate the accepted methods of striking an arc • describe the difference between a stringer bead and a weave bead • describe and demonstrate the proper tacking procedures and weld profile for a flat fillet weld • adjust the equipment to coincide with the type of electrode, type of weld and metal thickness • identify the attributes of a quality weld. 	<p>Students should have experience using different electrodes and diameters:</p> <ul style="list-style-type: none"> • E6011 (41011) • E6010 (41010) • E7018 (48018) • E7024 (48024).
<p>Implementation</p> <ul style="list-style-type: none"> • Shielded Metal Arc Welding 	<ul style="list-style-type: none"> • lay a consistent and even stringer bead and/or weave bead in the flat position • run a series of stringer beads in the flat position to create a layer of weld metal • make lap and square butt welds on mild steel plate in the flat position. 	

COURSE FAB2050: ARC WELDING 1 (continued)

Concept	Specific Outcomes	Notes
Assessment <ul style="list-style-type: none"><li>• Quality Control<li>• Career Preparation	<i>The student should:</i> <ul style="list-style-type: none"><li>• inspect a weld by considering the overall appearance, size and shape of the beads; plate penetration, fusion, undercutting and overlapping<li>• prepare a record of completed activities within a portfolio.	

COURSE FAB2060: ARC WELDING 2**Level:** Intermediate**Theme:** Fabrication Processes**Prerequisite:** FAB2050 Arc Welding 1**Description:** Students identify appropriate electrodes, 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 equipment and supplies and to instruction from an individual with formal, specialized training in arc welding practices.**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> explain the current systems used to classify electrodes in Canada and the United States identify strategies to assess and improve weld quality 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> accurate identification of the characteristics of three different electrodes using the Canadian Standards Association (CSA) and the American Welding Society (AWS) codes. <p><i>Assessment Tool</i> <i>Response Assessment: Electrode Coding, FAB2060-1</i></p> <p><i>Standard</i> <i>Response rating of 2</i></p>	10
	<ul style="list-style-type: none"> assessment of a weld given a cross-section and plan view and strategies to correct observed faults to include: <ul style="list-style-type: none"> use of the correct electrode type of current and current settings travel speed electrode angle and inclination <p><i>Assessment Tool</i> <i>Assessment Framework: Product Assessment, FABPRD</i></p>	15

COURSE FAB2060: ARC WELDING 2 (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> demonstrate basic shielded metal arc welding (SMAW) competencies in the horizontal position demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> completion of two successive single and multiple pass fillet welds in the horizontal position using available mild steel plate. <p><i>Assessment Tool</i> <i>Fabrication Process: Horizontal Lap and Tee Joints, FAB2060-2</i> <i>Illustrative Example: Horizontal Tee Joint – Single Pass, FAB2060-3</i></p> <p><i>Standard</i> <i>Welds are to be the correct width and height, free of voids, slag inclusions and apparent restarts, undercutting or overlapping; plate surfaces and adjacent beads have adequate penetration and fusion</i> <i>Performance rating of 2 for each applicable task</i></p> <ul style="list-style-type: none"> observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>75</p> <p>Integrated throughout</p>

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> Mild Steel Electrodes 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> describe the purpose of the core wire and electrode coating identify the characteristics of an electrode using AWS and CSA codes show the relationship between metal thickness, electrode size and welding amperage 	<p>Explain the importance of using the correct electrode for a given application and the difference between the way electrodes are classified in the AWS and CSA systems; e.g., an E-7018 is the same as a 48018 electrode.</p>

COURSE FAB2060: ARC WELDING 2 (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none"> • Arc Control • Weld Assessment • Joint Preparation 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • compare straight and reverse polarity and the resultant heat distribution • describe the advantages and disadvantages of using alternating and direct current • identify the cause and corrective measures for arc blow • describe the effects of a short and long arc on mild steel • describe the effects of improper: <ul style="list-style-type: none"> – amperage setting – arc length – travel speed • explain the importance of removing: <ul style="list-style-type: none"> – oil – paint – rust – mill scale from a joint before welding. 	<p>Explain the conditions that contribute to and prevent undercutting, overlapping, incorrect bead formation and lack of penetration.</p>
<p>Planning and Management</p> <ul style="list-style-type: none"> • Electrode Selection 	<ul style="list-style-type: none"> • describe the electrode(s) that can be used for a given application by considering: <ul style="list-style-type: none"> – properties of the base metal – weld position – flux requirements – material thickness – static and dynamic load characteristics. 	
<p>Implementation</p> <ul style="list-style-type: none"> • Shielded Metal Arc Welding 	<ul style="list-style-type: none"> • 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. 	

COURSE FAB2060: ARC WELDING 2 (continued)

Concept	Specific Outcomes	Notes
<p>Assessment</p> <ul style="list-style-type: none"> • Quality Control • Career Preparation 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • inspect a weld by considering the overall appearance, size and shape of the beads, plate penetration, fusion and degree of undercutting and overlapping • prepare a record of completed activities within a portfolio. 	<p>Have students understand that stray arc marks and excessive spatter also detract from the quality of the weld.</p>

COURSE FAB2070: GAS METAL ARC WELDING 1**Level:** Intermediate**Theme:** Fabrication Processes**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 gas metal arc welding (GMAW) equipment and supplies, and to instruction from an individual with formal, specialized training in arc welding practices.**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> outline the advantages and disadvantages of GMAW processes versus other forms of arc welding processes describe the characteristics of a desirable gas metal arc weld 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> a written or oral presentation that outlines four advantages of GMAW processes over other forms of arc welding processes <p><i>Assessment Tool</i> <i>Presentations/Reports: Advantages of Gas Metal Arc Welding, FAB2070-1</i></p> <p><i>Standard</i> <i>Performance rating of 2 for each applicable task</i></p>	10
	<ul style="list-style-type: none"> identification and description of five visual characteristics of a weld that meets trade standards <p><i>Assessment Tool</i> <i>Fabrication Process: Light Gauge Fillet Welds, FAB2070-2</i> <i>Illustrative Example:</i> <i>Vertical Lap Joint Fillet Weld, FAB2070-3</i></p> <p><i>Standard</i> <i>Performance rating of 3 for each applicable task</i></p>	10

COURSE FAB2070: GAS METAL ARC WELDING 1 (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • perform safe set-up and maintenance procedures with GMAW equipment • demonstrate safe GMAW practices to perform: <ul style="list-style-type: none"> – fillet welds on mild steel plate in the flat, horizontal and vertical positions – groove welds on mild steel plate in the flat position • demonstrate basic competencies 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • demonstration of safe start-up, shut-down and maintenance procedures, using GMAW equipment <p><i>Assessment Tools</i> <i>Equipment Checklist: GMAW Set-up and Maintenance Procedures, FABEQUIP-6</i></p> <p><i>Standard</i> <i>All procedures to be performed correctly</i></p> <ul style="list-style-type: none"> • demonstration of safe GMAW practices and the completion of: <ul style="list-style-type: none"> – two flat, two horizontal and two vertical fillet welds on mild steel plate, using GMAW processes – two flat groove welds on mild steel plate, using GMAW processes <p><i>Assessment Tool</i> <i>Fabrication Process: Light Gauge Fillet Welds, FAB2070-2</i> <i>Illustrative Example:</i> <i>Vertical Lap Joint Fillet Weld, FAB2070-3</i></p> <p><i>Standard</i> <i>Welds are to be free of visible structural defects and are to have uniform reinforcement</i> <i>Performance rating of 3 for each applicable task</i></p> <ul style="list-style-type: none"> • observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>10</p> <p>70</p> <p>Integrated throughout</p>

COURSE FAB2070: GAS METAL ARC WELDING 1 (continued)

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> • Health and Safety • GMAW Variables • Weld Quality 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe safety issues related to: <ul style="list-style-type: none"> – the use of personal protective equipment – handling and storage of consumables – keeping the welding area free of hazards – insuring adequate ventilation • describe a safety plan in case of accident • identify the advantages and disadvantages of GMAW processes as compared to other arc welding processes • identify the variables that can directly affect weld quality; i.e.: <ul style="list-style-type: none"> – the welding current and voltage – modes of metal transfer; e.g.: <ul style="list-style-type: none"> • short arc • globular • spray arc – diameter and type of filler metal – type and condition of equipment – welding technique; e.g.: <ul style="list-style-type: none"> • forehand or pushing • backhand or pulling • identify possible causes of welding defects; e.g.: <ul style="list-style-type: none"> – surface porosity – subsurface porosity – lack of fusion – burn through – lack of penetration – coldlapping • identify problems common to out of position welding 	<p>Demonstrate forehand and backhand welding techniques.</p>

COURSE FAB2070: GAS METAL ARC WELDING 1 (continued)

Concept	Specific Outcomes	Notes
<p>Planning and Management</p> <ul style="list-style-type: none"> • Equipment Set-up • Preparation • Equipment Maintenance 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • apply safe work practices and procedures: <ul style="list-style-type: none"> – select and use appropriate personal protective equipment – maintain a clean and tidy work station – demonstrate safe tool/material handling and storage techniques • for a given type of weld and/or weldment, select the appropriate: <ul style="list-style-type: none"> – wire type, size and feed rate – current – shielding gas type and flow rate • prepare and clean all surfaces to be welded • properly position metal for welding • describe and demonstrate the maintenance required for wire drive systems and gun assemblies 	
<p>Implementation</p> <ul style="list-style-type: none"> • Gas Metal Arc Welding 	<ul style="list-style-type: none"> • demonstrate safe GMAW techniques and perform fillet welds in the flat, horizontal and vertical positions on mild steel plate • demonstrate safe GMAW techniques and perform groove welds in the flat position on mild steel plate 	
<p>Assessment</p> <ul style="list-style-type: none"> • Quality Control • Career Preparation 	<ul style="list-style-type: none"> • complete a visual inspection (i.e., non-destructive test) by observing and assessing: <ul style="list-style-type: none"> – overall size, shape and appearance of the beads – plate penetration – fusion – degree of undercutting and overlapping • perform a destructive test where appropriate • prepare a record of completed activities within a portfolio 	

COURSE FAB2090: SHEET FABRICATION 2 (MACHINE PROCESSES)**Level:** Intermediate**Theme:** Fabrication Processes**Prerequisite:** FAB1090 Sheet Fabrication 1 (Hand Processes)**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.**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> identify and describe common types of stock sheet metal materials and related tools demonstrate approved materials handling and storage practices perform basic sheet metal fabrication skills and practices to produce a product 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> accurate identification and description of five different sheet metal materials and 10 sheet metal machine tools observed performance related to: <ul style="list-style-type: none"> use of personal protective equipment <ul style="list-style-type: none"> correct lifting techniques measures taken to protect materials from surface damage proper storage of cut-offs successful completion of a given rectangular sheet metal product that uses one or more common seams and hems. <p><i>Assessment Tool</i> <i>Product Assessment: Basic Sheet Metal Products, FAB2090-1</i></p> <p><i>Standard</i> <i>The product should be structurally sound, free of surface defects and meet the stated size and shape specifications.</i> <i>Performance rating of 2 for each applicable task</i></p>	<p>20</p> <p>10</p> <p>70</p>

COURSE FAB2090: SHEET FABRICATION 2 (MACHINE PROCESSES) (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>Integrated throughout</p>

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> Sheet Stock Identification and Handling Cutting Sheet Stock Bending Sheet Stock Seaming Riveting Threaded Fasteners Soldering and Welding 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> identify common samples of sheet metal stock by their appearance and properties describe the most appropriate way to safely handle and store metal stock explain how sheet metal thicknesses are measured and stated explain the safe use of hand and machine tools to make internal and external: <ul style="list-style-type: none"> straight cuts curved cuts explain the safe use of hand and machine tools to form a product describe and give examples of uses for: <ul style="list-style-type: none"> flange/butt lap folded grooved seams describe the advantages and disadvantages of: <ul style="list-style-type: none"> tinner's rivets pop rivets identify the common sizes and types of metal fastening screws and bolts identify appropriate conditions and techniques to solder or weld a seam 	<p>Point out that even though sheet metal work tends to be focused around a specific trade, the principles learned here have widespread applications.</p>

COURSE FAB2090: SHEET FABRICATION 2 (MACHINE PROCESSES) (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none"> • Finishing 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • research common finishing techniques. 	<p>Suggested finishes include:</p> <ul style="list-style-type: none"> – paint – powder spray – lacquer.
<p>Planning and Management</p> <ul style="list-style-type: none"> • Pattern Layout • Operation Sequencing 	<ul style="list-style-type: none"> • calculate the appropriate hem and seam allowances for a given product • calculate and mark the sequence and direction of all bends. 	
<p>Implementation</p> <ul style="list-style-type: none"> • Material Processing and Fabrication 	<ul style="list-style-type: none"> • demonstrate basic sheet metal process and fabrication skills related to: <ul style="list-style-type: none"> – layout – cutting – bending – fastening procedures. 	
<p>Assessment</p> <ul style="list-style-type: none"> • Quality Control • Career Preparation 	<ul style="list-style-type: none"> • inspect a completed rectangular product for the overall attention to: <ul style="list-style-type: none"> – fit of seams – accuracy of measurement – structural soundness – quality of finish • prepare a record of completed activities within a portfolio. 	

COURSE FAB2100: SHEET FABRICATION 3 (PARALLEL LINE)**Level:** Intermediate**Theme:** Fabrication Processes**Prerequisite:** FAB2090 Sheet Fabrication 2 (Machine Processes)**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.**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • describe and give examples of parallel line developments • create a parallel line development, using standard drawing and layout practices • apply sheet metal fabrication principles skills to fabricate a product, using parallel line development 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • correct description and identification of three sheet metal products that are made using parallel line developments • use of approved drawing practices to develop parallel line developments that can be used to produce products from light gauge sheet stock • the accurate layout and fabrication of a sheet metal product that uses one or more seams and edge treatments. <p><i>Assessment Tool</i> <i>Product Assessment: Parallel Line Developments, FAB2100-1</i></p> <p><i>Standard</i> <i>The product should be structurally sound and free of surface blemishes; seams and hems should be tight fitting and appropriate. Overall dimensions should meet design specifications</i> <i>Performance rating of 2 for each applicable task</i></p>	<p>15</p> <p>25</p> <p>60</p>

COURSE FAB2100: SHEET FABRICATION 3 (PARALLEL LINE) (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>Integrated throughout</p>

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> Health and Safety Pattern Development Pattern Types Hems and Edges 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> describe: <ul style="list-style-type: none"> the use of appropriate personal protective equipment proper storage of consumables a safety plan in case of accident explain how to provide adequate air quality for welding, soldering and finishing list and describe the following pattern developments: <ul style="list-style-type: none"> parallel line radial line triangulations explain the use of: <ul style="list-style-type: none"> full patterns half patterns pierced patterns identify and describe the purpose of a: <ul style="list-style-type: none"> standing edge single hem double hem wired edge describe how to calculate the material allowance for a wire edge 	<p>Provide examples of products that are developed through straight, parallel, radial line and triangulation.</p>

COURSE FAB2100: SHEET FABRICATION 3 (PARALLEL LINE) (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none"> • Seams • Shearing • Soft Soldering • Other Fastening Techniques 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • identify and describe the use of the following seams: <ul style="list-style-type: none"> – plain lap and flush lap – inside and outside lap – single and double seam – grooved joint – Pittsburgh lock • explain how and when to use: <ul style="list-style-type: none"> – combination, straight and aviation snips – notcher – squaring shears • describe how to forge and tin solder coppers • select the appropriate flux for ferrous and nonferrous applications • explain how to sweat solder lap, single- and double-seamed joints • explain when it is appropriate to use: <ul style="list-style-type: none"> – spot welders – solid rivets – pop rivets. 	
<p>Planning and Management</p> <ul style="list-style-type: none"> • Pattern Development • Operation Sequencing 	<ul style="list-style-type: none"> • calculate the material allowance for: <ul style="list-style-type: none"> – double and single seam – Pittsburgh lock • prepare a parallel line development • create a systematic sequence of operations to fabricate a parallel line product. 	<p>Students without a background in drafting may require extra assistance to prepare a pattern.</p>
<p>Implementation</p> <ul style="list-style-type: none"> • Material Processing and Fabrication 	<ul style="list-style-type: none"> • demonstrate basic sheet metal process and fabrication skills related to specific seam and edge treatments and fastening techniques. 	<p>Consider having students build a hinged tool box or carryall.</p>

COURSE FAB2100: SHEET FABRICATION 3 (PARALLEL LINE) (continued)

Concept	Specific Outcomes	Notes
<p>Assessment</p> <ul style="list-style-type: none">• Quality Control• Career Preparation	<p><i>The student should:</i></p> <ul style="list-style-type: none">• list criteria to assess a sheet metal product and apply it to the evaluation of a completed product• prepare a record of completed activities within a portfolio.	<p>Consider such factors as product design, usefulness, durability and overall workmanship.</p>

COURSE FAB2110: FORGING FUNDAMENTALS

Level: Intermediate

Theme: Fabrication Processes

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

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<i>The student will:</i> <ul style="list-style-type: none">• identify health and safety hazards associated with metal forging, and take preventive measures to avoid accidents and personal injury to self and others• identify and describe the basic tools and processes used in forging• demonstrate basic metal forging skills and practices	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none">• observed performance in a typical work setting, related to:<ul style="list-style-type: none">– appropriate selection and use of personal protective equipment– safe use of a forge and forging tools– maintenance of a clean and tidy workstation– safe handling and storage of tools and materials• accurate written or oral description of a forge; anvil and accessories; identification and description of drawing, tapering, bending, twisting and upsetting processes• application of forging principles to shape a machine tool or other product. <p><i>Assessment Tool</i> <i>Product Assessment: Forge Work, FAB2110-1</i></p> <p><i>Standard</i> <i>The product is to be evenly shaped, finished and heat treated according to the stated specifications.</i> <i>Performance rating of 2 for each applicable task</i></p>	<p>10</p> <p>20</p> <p>70</p>

COURSE FAB2110: FORGING FUNDAMENTALS (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>Integrated throughout</p>

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> Forging Hand Forging 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> identify common and machine parts that are made by forging compare the grain structure of a part shaped by forging with one shaped by casting or machining identify and describe the types of hand tools that are used in forging describe the use of: <ul style="list-style-type: none"> hammers tongs sets fullers punches swages observe and note the processes of: <ul style="list-style-type: none"> tapering draw out bending twisting upsetting 	<p>Hand forging is not widely practised in industry; however, the principles learned here are basic to all machine processes.</p>

COURSE FAB2110: FORGING FUNDAMENTALS (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none"> • Heating • Heat Treating • Drop Forging 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe the parts of a solid fuel or gas-fired forge • explain how temperatures are controlled • describe the chemical reactions that take place between the heating elements and the work piece • describe how the combination of heating and quenching can be used to control the shaping of the metal • describe the processes of hardening, tempering, annealing and normalizing related to forging • compare the process of drop forging with that of conventional forging techniques. 	<p>Discuss the advantages and disadvantages of a gas-fired and solid fuel forge.</p> <p>Heat treating concepts are further developed in Metallurgy Fundamentals (FAB3020).</p>
<p>Planning and Management</p> <ul style="list-style-type: none"> • Health and Safety • Operation Schedule 	<ul style="list-style-type: none"> • identify the appropriate personal protective equipment used in forging • describe the approved start-up and shut-down procedures for a given forge • create a sequence of forging operations by analyzing an existing forged part or shop drawing. 	
<p>Implementation</p>	<ul style="list-style-type: none"> • demonstrate basic forging skills using a variety of forging tools. 	
<p>Assessment</p> <ul style="list-style-type: none"> • Career Information • Career Preparation 	<ul style="list-style-type: none"> • evaluate further local training and employment opportunities as a/an: <ul style="list-style-type: none"> – ornamental iron worker – farrier • prepare a record of completed activities within a portfolio. 	

COURSE FAB2120: FOUNDRY 2 (SPLIT PATTERN)**Level:** Intermediate**Theme:** Production Systems and Processes**Prerequisite:** FAB1120 Foundry 1 (One-piece Pattern)**Description:** Students expand their pattern making and foundry skills to produce split pattern molds 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.**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> describe the essential similarities and differences between a one-piece pattern and a split pattern describe and perform safe start-up and shut-down procedures for the operation of a foundry furnace demonstrate basic pattern making skills to make a split pattern 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> oral or written response that outlines the important similarities and differences between a one-piece pattern and mold and a split pattern and mold. <p><i>Assessment Tool</i> <i>Response Assessment: Split Pattern and Mold Making, FAB2120-1</i></p> <p><i>Standard</i> <i>Response rating of 2</i></p>	10
	<ul style="list-style-type: none"> demonstration of approved foundry furnace start-up and shut-down procedures and safe handling and pouring of molten metal 	15
	<ul style="list-style-type: none"> successful completion of a simple split pattern. <p><i>Assessment Tool</i> <i>Product Assessment: Pattern Work and Mold Making, FAB2120-2</i></p> <p><i>Standard</i> <i>The pattern should incorporate the appropriate allowance for shrinkage and sufficient draft to allow for easy extraction.</i> <i>Performance rating of 2 for each applicable task</i></p>	40

COURSE FAB2120: FOUNDRY 2 (SPLIT PATTERN) (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • apply sand casting principles and skills to make a casting from a split pattern • demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • successful completion of a mold and casting using a split pattern. <p><i>Assessment Tool</i> <i>Product Assessment: Pattern Work and Mold Making, FAB2120–2</i></p> <p><i>Standard</i> <i>The mold should be appropriately vented gated and rammed. The casting should be clean and free of voids; removal of gates should not distract from the overall appearance of the product</i></p> <p><i>Performance rating of 2 for each applicable task</i></p> <ul style="list-style-type: none"> • observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p style="text-align: center;">35</p> <p style="text-align: center;">Integrated throughout</p>

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> • Foundry Processes and Products • Pattern Making 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • from a selection of cast objects, list those made from two-part patterns and identify the “parting-line” on each casting • describe the type of pattern used to make a mold for cylindrical/spherical objects • explain how a split pattern is aligned and why this is necessary • compare the shrinkage allowances for: <ul style="list-style-type: none"> – aluminium – brass – cast iron 	<p>The same emphasis should be placed on pattern making as is placed on casting and finishing a product.</p>

COURSE FAB2120: FOUNDRY 2 (SPLIT PATTERN) (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none"> • Mold Making • Foundry Furnaces 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe the correct use of foundry tools and equipment to make a mold from a two-part pattern • explain how the two parts of the mold are aligned correctly • list and describe common foundry furnaces and accessories • identify safe start-up and shut-down procedures for a given furnace. 	<p>Demonstrate how to safely start up and shut-down a foundry furnace.</p>
<p>Planning and Management</p> <ul style="list-style-type: none"> • Heating and Pouring • Health and Safety 	<ul style="list-style-type: none"> • describe the correct pouring temperature for both aluminium alloy and lead-based alloys • identify appropriate fluxes to be used with the melting process • identify the dangers relating to: <ul style="list-style-type: none"> – handling ceramic crucibles – moisture in contact with molten metal – metals splashing – molds incorrectly vented – metal escape if mating flask surfaces are damaged – water as a sand binder – fumes from metal, fluxing and binders – common foundry practices to avoid injury in all of the above • describe a safety plan in case of accident. 	
<p>Implementation</p> <ul style="list-style-type: none"> • Material Processing 	<ul style="list-style-type: none"> • use the appropriate tools, materials and processes to: <ul style="list-style-type: none"> – construct a split pattern – create a sand mold – pour – cool – remove flash, gates and runners – finish a sand casting. 	

COURSE FAB2120: FOUNDRY 2 (SPLIT PATTERN) (continued)

Concept	Specific Outcomes	Notes
Assessment <ul style="list-style-type: none"><li>• Quality Control<li>• Career Preparation	<i>The student should:</i> <ul style="list-style-type: none"><li>• identify the cause of porosity in a casting and take appropriate measures to correct the problem<li>• prepare a record of completed activities within a portfolio.	

COURSE FAB2130: PRECISION TURNING 1**Level:** Intermediate**Theme:** Production Systems and Processes**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 metal lathe and accessories and to instruction from an individual with specialized training in machining practices.**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> identify health and safety hazards specific to metal turning, and take preventive measures to avoid accidents and personal injury to self and others perform safe metal lathe set-up, operation and shut-down procedures 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> observed performance related to: <ul style="list-style-type: none"> appropriate selection and use of personal protective equipment containment of long hair, loose clothing, removal of rings and other forms of jewellery safe handling of materials precautions taken to ensure the safety of others demonstration of approved practices to: <ul style="list-style-type: none"> mount work in a three- or four-jaw chuck mount work using a chuck and a live or dead centre mount work between centres set-up for a taper. <p><i>Assessment Tools</i> <i>Equipment Checklist: Metal Lathe</i> <i>FABEQUIP-3</i></p> <p><i>Standard</i> <i>All procedures to be performed correctly</i></p>	10

COURSE FAB2130: PRECISION TURNING 1 (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • demonstrate basic straight turning and finishing skills • demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • completion of the following machining operations: <ul style="list-style-type: none"> – face stock in a three- or four-jaw chuck – drill centre holes – turn work in a three- or four-jaw chuck – turn work between centres – knurl and finish. <p><i>Assessment Tool</i> <i>Fabrication Process: Straight Turning, FAB2130-1</i> <i>Illustrative Example: Screwdriver, FAB2130–2</i></p> <p><i>Standard</i> <i>Dimensions and levels of finish are to be within stated tolerances and specifications</i> <i>Performance rating of 2 for each applicable task</i></p> <ul style="list-style-type: none"> • observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p style="text-align: center;">75</p> <p>Integrated throughout</p>

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> • Health and Safety • Machining Characteristics 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe safety procedures related to the use and operation of metal turning equipment • identify and correct common hazards related to machine lathe and turning processes • describe a safety plan in case of accident • compare the machining characteristics of common ferrous and non-ferrous materials 	<p>Review the operation of a metal lathe, identify accessories and point out how a lathe is sized by the length of its bed and swing.</p> <p>Explain how these characteristics affect the choice of cutting tool, spindle speeds and feed rates.</p>

COURSE FAB2130: PRECISION TURNING 1 (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none"> • Lathe Parts and Accessories • Machine Operations 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe the basic parts and accessories of an engine lathe • explain the difference between a three- and a four-jaw chuck • identify cutting and forming tools that are used for: <ul style="list-style-type: none"> – roughing – facing – drilling – boring – parting – knurling – finishing • describe the correct procedures to: <ul style="list-style-type: none"> – mount work in a three- and/or four-jaw chuck – mount work between centres • describe set-up procedures to face, centre drill, straight turn and drill stock • describe the factors that affect spindle speed, feed rate and depth of cut • describe safe finishing techniques, using files and abrasives • identify and describe lathe and lathe tool lubricants and coolants. 	<p>Demonstrate how to centre an object in a four-jaw chuck and how to select and centre a cutting tool.</p>
<p>Planning and Management</p> <ul style="list-style-type: none"> • Print Reading 	<ul style="list-style-type: none"> • from a machine drawing of a turned part, identify: <ul style="list-style-type: none"> – overall dimension – types of material – types of finishes – fits and tolerances • list and describe the machining operations in a logical order • calculate the appropriate cutting speeds, feed rates and depth of cuts for rough turning, finishing, drilling and knurling different materials. 	<p>Compare the use and accuracy of mechanical and electronic measuring devices such as a vernier and digital caliper.</p> <p>Use appropriate tables and charts.</p>

COURSE FAB2130: PRECISION TURNING 1 (continued)

Concept	Specific Outcomes	Notes
<p>Implementation</p> <ul style="list-style-type: none"> • Lathe Work 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • demonstrate basic turning skills related to: <ul style="list-style-type: none"> – facing – centre drilling – straight turning – drilling – boring – knurling – parting – finishing <p>common machineable metals and/or plastics.</p>	<p>The fabrication of products, such as a mallet and screwdriver handle, provide opportunities for the student to develop a wide range of lathe skills.</p>
<p>Assessment</p> <ul style="list-style-type: none"> • Quality Control • Career Preparation 	<ul style="list-style-type: none"> • research ways to improve output quality and reduce machining time • prepare a record of completed activities within a portfolio. 	

COURSE FAB2140: PRECISION MILLING 1

Level:	Intermediate
Theme:	Production Systems and Processes
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 vertical and/or horizontal mill and accessories and to instruction from an individual with specialized training in machining practices.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<i>The student will:</i> <ul style="list-style-type: none"> identify health and safety hazards specific to milling operations, and take preventive measures to avoid accidents and personal injury to self and others perform safe milling machine set-up, operation and shut-down procedures 	<i>Assessment of student achievement should be based on:</i> <ul style="list-style-type: none"> observed performance related to: <ul style="list-style-type: none"> appropriate selection and use of personal protective equipment containment of long hair, loose clothing, removal of rings and other forms of jewellery safe handling of materials keeping a clean and orderly work area demonstration of approved practices related to the safe set-up of a vertical and/or horizontal mill. 	10
	<i>Assessment Tool</i> <i>Equipment Checklist: Milling Machines, FABEQUIP-4</i> <i>Standard</i> <i>All procedures to be performed correctly</i>	15

COURSE FAB2140: PRECISION MILLING 1 (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none"> • Lubricants and Cutting Fluids • Machine Operation 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • use the recommended lubricants for a given milling machine • identify the purpose of a cutting fluid and identify common types • research typical set-up procedures for horizontal and/or vertical milling to create flat surfaces, grooves and chamfers • identify the factors that determine cutting speeds, feed rates and depths of cuts • explain the advantages and disadvantages of upcutting and climb milling. 	<p>Refer to product labels and instructions for proper use and handling.</p> <p>Do not attempt climb milling without backlash eliminators.</p>
<p>Planning and Management</p> <ul style="list-style-type: none"> • Print Reading • Squaring Operations 	<ul style="list-style-type: none"> • identify from a machine drawing of a milled part, the: <ul style="list-style-type: none"> – overall dimensions and tolerance – quality of surface finish – most appropriate milling machine and cutters to be used • list and describe the machining operations to square stock, bevel and chamfer surfaces • calculate the appropriate cutting speeds, feed rates and depth of cuts for a specific operation. 	
<p>Implementation</p> <ul style="list-style-type: none"> • Milling 	<ul style="list-style-type: none"> • demonstrate basic competencies using a milling machine to rough size, square, bevel, chamfer and finish machine parts to the prescribed tolerances and specification. 	
<p>Assessment</p> <ul style="list-style-type: none"> • Quality Control • Career Preparation 	<ul style="list-style-type: none"> • research ways to improve output quality and machining time • prepare a record of completed activities within a portfolio. 	

COURSE FAB2150: CNC TURNING (COMPUTER NUMERICAL CONTROL)**Level:** Intermediate**Theme:** Production Systems and Processes**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 CNC turning centre and to instruction from an individual with specialized training in CNC practices.**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> identify safety hazards associated with CNC equipment and, take preventive measures to avoid accidents and personal injury to self and others demonstrate two dimensional programming and/or CAD skills apply CNC programming skills to manufacture a turned part 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> ongoing observation related to: <ul style="list-style-type: none"> appropriate selection and use of personal protective equipment use of safety covers and guards use of dry runs development of a 2-D program to produce a machineable part on a CNC lathe using absolute coordinates and/or CAD file conversion performing the appropriate set-up testing and running procedures to produce a turned part. <p><i>Assessment Tool</i> <i>Assessment Framework: Product Assessment, FABPRD</i></p> <p><i>Standard</i> <i>Product is to be within stated machine tolerances.</i> <i>Performance rating of 2 for each applicable task</i></p>	<p>10</p> <p>60</p> <p>30</p>

COURSE FAB2150: CNC TURNING (COMPUTER NUMERICAL CONTROL) (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>Integrated throughout</p>

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> Lathe Operation 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> describe the principles of machining and the operation of a metal lathe analyze a CNC lathe and describe how turning speeds and feed rates are controlled; tools and work pieces are mounted identify the turning capabilities of a lathe; e.g.: <ul style="list-style-type: none"> types of materials set-ups cutting tools describe the safety features that are built into the CNC equipment 	<p>Demonstrate the proper set-up and operation of a CNC lathe.</p>
<ul style="list-style-type: none"> Programming 	<ul style="list-style-type: none"> identify the relationship of the x and y axis on a metal lathe explain how to program a lathe using absolute coordinates 	<p>More and more industries are using computer-controlled equipment. Students who enter the machining field will require a knowledge of basic programming principles.</p> <p>Use the Cartesian system to describe a point.</p>
<ul style="list-style-type: none"> Dimensioning Systems 	<ul style="list-style-type: none"> compare the advantages of using incremental and absolute systems of measurements explain the difference between using a fixed zero and full floating zero 	
<ul style="list-style-type: none"> G and M Codes 	<ul style="list-style-type: none"> describe the purpose of G and M codes explain how canned cycles are used in programming 	

COURSE FAB2150: CNC TURNING (COMPUTER NUMERICAL CONTROL) (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none"> • CAD/CAM 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • explain how a CAD file can be converted to a machineable part file. 	
<p>Planning and Management</p> <ul style="list-style-type: none"> • Health and Safety • 2-D Programming 	<ul style="list-style-type: none"> • describe the: <ul style="list-style-type: none"> – appropriate use of protective equipment and clothing – need to keep work area clean and free of hazards – importance of following the manufacturer’s instructions and keeping all guards in place in working order • describe a safety plan in case of accident • prepare a program from a print using absolute coordinates and/or produce a CAD design • simulate the tool path using computer graphics. 	
<p>Implementation</p> <ul style="list-style-type: none"> • Production 	<ul style="list-style-type: none"> • load the program or convert a CAD file • mount and secure the workpiece • identify reference and clearance points • mount and set cutting tool(s) • complete a test run • manufacture the part. 	
<p>Assessment</p> <ul style="list-style-type: none"> • Quality Control • Career Preparation 	<ul style="list-style-type: none"> • inspect the part to see that it meets the print dimensions, tolerances and specifications • prepare a record of completed activities within a portfolio. 	

COURSE FAB2160: CUSTOM FABRICATION**Level:** Intermediate**Theme:** Production Systems and Processes**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**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> demonstrate appropriate communicating and planning skills demonstrate effective resource management skills and practices demonstrate custom fabrication competencies 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> observed communication with a client that includes: <ul style="list-style-type: none"> methods used to determine the customer needs a design proposal and approval cost and time estimate contract terms applied resource management skills used to access and deploy human and material resources successful fabrication of a custom product that fulfills the conditions of the contract. <p><i>Assessment Tool</i> <i>Product Assessment: Custom Work, FAB2160-1</i></p> <p><i>Standard</i> <i>Performance rating of 2 for each applicable task</i></p>	<p>25</p> <p>25</p> <p>50</p>
<ul style="list-style-type: none"> demonstrate basic competencies. 	<ul style="list-style-type: none"> observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>Integrated throughout</p>

COURSE FAB2160: CUSTOM FABRICATION (continued)

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> • Custom Manufacturing • Client Needs • Management Skills 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe the advantages and disadvantages of custom production • list the steps to follow in determining a customer's needs • identify and describe key management elements, such as: <ul style="list-style-type: none"> – organizing – designing – producing – controlling. 	<p>Encourage students to work with a client to determine his or her product needs, develop a proposal and complete a project to satisfy the customer rather than simply build a project for themselves.</p>
<p>Planning and Management</p> <ul style="list-style-type: none"> • Customer Interface • Construction and Fabrication Planning 	<ul style="list-style-type: none"> • identify the product/structure specifications through consultation with the customer • create a suitable design, timeline and budget by working collaboratively with the customer • explain to the customer any need to make changes • change orders as the customer sees necessary • complete a customer satisfaction follow-up • identify the types and properties of the materials to be used • explain whether any specialized equipment will be needed to complete the task • evaluate the need to construct special jigs or fixtures • describe any unique finishing and installation requirements. 	

COURSE FAB2160: CUSTOM FABRICATION (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none"> • Cooperative Work Strategies 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • explain the need to: <ul style="list-style-type: none"> – identify group and individual responsibilities – identify and capitalize on individual strengths – participate in group as well as self-evaluative processes – develop strategies for positive criticism. 	
<p>Implementation</p> <ul style="list-style-type: none"> • Construction and Fabrication 	<ul style="list-style-type: none"> • complete responsibilities to: <ul style="list-style-type: none"> – break out materials according to a prearranged plan – process materials with a minimum number of set ups – assemble, finish and prepare the product/ structure for delivery or installation. 	
<p>Assessment</p> <ul style="list-style-type: none"> • Follow-up • Career Preparation 	<ul style="list-style-type: none"> • research ways to determine customer satisfaction • identify future service requirements • explain a method for gaining new leads • prepare a record of completed activities within a portfolio. 	

COURSE FAB2170: PIPE FITTING**Level:** Intermediate**Theme:** Fabrication Processes**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**Curriculum and Assessment Standards**

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> identify and describe common pipe fitting materials and applications research and profile a trade or occupation within the pipe fitting field demonstrate approved methods of joining common types of pipes and materials 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> accurate identification and description of four different pipe materials and appropriate applications 	25
	<ul style="list-style-type: none"> presentation of a career profile that outlines: <ul style="list-style-type: none"> present and future career opportunities skill requirements training opportunities. <p><i>Assessment Tool</i> <i>Research Process: Piping Systems, FAB2170-1</i></p> <p><i>Standard</i> <i>Performance rating of 2 for each applicable task</i></p>	15
	<ul style="list-style-type: none"> completion of a simple piping system that incorporates a variety of pipe materials, fittings and components. <p><i>Assessment Tool</i> <i>Assessment Framework: Activity Assessment, FABACT</i></p> <p><i>Standard</i> <i>The system should be accurately laid out and connected with tight joints. Overall workmanship should meet trade expectations</i> <i>Performance rating of 2 for each applicable task</i></p>	60

COURSE FAB2170: PIPE FITTING (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>Integrated throughout</p>

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> Piping Systems Pipe Materials Pipe Components Joining Pipes 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> research and describe the types of piping systems used to provide: <ul style="list-style-type: none"> gas supply systems sprinkler systems hot water and heating services steam and superheated steam cooling systems petroleum and chemical products identify and provide applications for: <ul style="list-style-type: none"> standard pipe (black and galvanized) thin wall pipe extra strong (xs) pipe research and give examples of how common piping materials are coded and specified list and describe components found in piping systems; e.g.: <ul style="list-style-type: none"> flanges and fittings valves traps pumps describe appropriate applications and methods of joining pipe, by: <ul style="list-style-type: none"> threading welding mechanical fasteners. 	<p>Discuss residential and commercial applications of piping systems.</p>

COURSE FAB2170: PIPE FITTING (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none"> • Joining Pipes (continued) • Calculations and Layout 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe how to join dissimilar pipe materials; e.g.: <ul style="list-style-type: none"> – steel pipe to copper – steel pipe to plastic • analyze various methods to measure pipe lengths and calculate offsets • identify appropriate methods of laying, hanging and securing pipe. 	
<p>Planning and Management</p> <ul style="list-style-type: none"> • Print Reading 	<ul style="list-style-type: none"> • describe the appropriate type and size of pipe, fittings and components for a given drawing • calculate the length of a given offset. 	
<p>Implementation</p> <ul style="list-style-type: none"> • Health and Safety • Pipe Fabrication 	<ul style="list-style-type: none"> • identify all safety procedures related to: <ul style="list-style-type: none"> – use of personal protective clothing – lifting heavy weights – use of ladders and scaffolds – use of tools and materials • describe a safety plan in case of accident • use the appropriate tools to make a small pipe assembly that incorporates a variety of fittings and components. 	<p>Students may have to go off campus to gain practical experience in this course.</p>
<p>Assessment</p> <ul style="list-style-type: none"> • Quality Control • Career Information 	<ul style="list-style-type: none"> • test a simple pipe assembly for: <ul style="list-style-type: none"> – accuracy – tightness of joints – overall workmanship • research career and further training opportunities related to pipe work • evaluate personal interests and abilities related to making realistic career choices 	

COURSE FAB2170: PIPE FITTING (continued)

Concept	Specific Outcomes	Notes
<ul style="list-style-type: none">• Career Preparation	<i>The student should:</i> <ul style="list-style-type: none">• prepare a record of completed activities within a portfolio.	

COURSE FAB2048: FLUX CORE ARC WELDING 1

Level: Intermediate

Theme: Fabrication Processes

Prerequisite: FAB1048 Semi-automated/Automated Welding

Description: Students develop an understanding of the advantages and disadvantages of flux core arc welding (FCAW) processes, and 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 flux core arc welding (FCAW) equipment and supplies, and to instruction from an individual with formal, specialized training in arc welding practices.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> outline the advantages and disadvantages of FCAW processes versus other forms of arc welding processes describe the characteristics of a desirable flux core arc weld 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> a written or oral presentation that outlines four advantages of FCAW processes over other forms of arc welding processes <p><i>Assessment Tool</i> <i>Presentations/Reports: Advantages of Flux Core Arc Welding, FAB2048-1</i></p> <p><i>Standard</i> <i>Performance rating of 2 for each applicable task</i></p>	10
	<ul style="list-style-type: none"> identification and description of five visual characteristics of a weld that meets trade standards <p><i>Assessment Tool</i> <i>Fabrication Process: Fillet and Butt Welding on Mild Steel, FAB2048-2</i></p> <p><i>Illustrative Examples:</i> <i>Flat Tee Fillet Weld, FAB2048-4</i> <i>Horizontal Tee Fillet Weld, FAB2048-5</i> <i>Vertical Tee Fillet Weld, FAB2048-6</i> <i>Flat Single Vee Butt Joint Weld, FAB2048-7</i></p> <p><i>Standard</i> <i>Performance rating of 3 for each applicable task</i></p>	10

COURSE FAB2048: FLUX CORE ARC WELDING 1 (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • perform safe set-up and maintenance procedures with FCAW equipment • demonstrate safe FCAW practices and perform: <ul style="list-style-type: none"> – fillet welds on mild steel plate in the flat, horizontal and vertical positions – groove welds on mild steel plate in the flat position • demonstrate basic competencies 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • demonstration of safe start-up, shut-down and maintenance procedures, using FCAW equipment <p><i>Assessment Tools</i> <i>Equipment Checklist: FCAW Set-up and Maintenance Procedures, FAB2048-3</i></p> <p><i>Standard</i> <i>All procedures to be performed correctly</i></p> <ul style="list-style-type: none"> • demonstration of safe FCAW practices and the completion of: <ul style="list-style-type: none"> – two flat, two horizontal and two vertical fillet welds on mild steel plate, using FCAW processes – two flat groove welds on mild steel plate, using FCAW processes <p><i>Assessment Tool</i> <i>Fabrication Process: Fillet and Butt Welding on Mild Steel, FAB2048-2</i></p> <p><i>Illustrative Examples:</i> <i>Flat Tee Fillet Weld, FAB2048-4</i> <i>Horizontal Tee Fillet Weld, FAB2048-5</i> <i>Vertical Tee Fillet Weld, FAB2048-6</i> <i>Flat Single Vee Butt Joint Weld, FAB2048-7</i></p> <p><i>Standard</i> <i>Welds are to be free of visible structural defects and are to have uniform reinforcement</i> <i>Performance rating of 3 for each applicable task</i></p> <ul style="list-style-type: none"> • observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>10</p> <p>70</p> <p>Integrated throughout</p>

COURSE FAB2048: FLUX CORE ARC WELDING 1 (continued)

Concept	Specific Outcomes	Notes
<p>Orientation</p> <ul style="list-style-type: none"> • Health and Safety • FCAW Variables • Weld Quality 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe safety issues related to: <ul style="list-style-type: none"> – the use of personal protective equipment – handling and storage of consumables – keeping the welding area free of hazards – insuring adequate ventilation • describe a safety plan in case of accident • identify the advantages and disadvantages of FCAW processes as compared to other arc welding processes • identify the variables that can directly affect weld quality; i.e.: <ul style="list-style-type: none"> – the welding current and voltage – modes of metal transfer; e.g.: <ul style="list-style-type: none"> • short arc • globular • spray arc – diameter and type of filler metal – type and condition of equipment – welding technique; e.g.: <ul style="list-style-type: none"> • forehand or pushing • backhand or pulling • identify possible causes of welding defects; e.g.: <ul style="list-style-type: none"> – surface porosity – subsurface porosity – lack of fusion – burn through – lack of penetration – coldlapping • identify problems common to out of position welding 	<p>Demonstrate forehand and backhand welding techniques.</p>

COURSE FAB2048: FLUX CORE ARC WELDING 1 (continued)

Concept	Specific Outcomes	Notes
<p>Planning and Management</p> <ul style="list-style-type: none"> • Equipment Set-up • Preparation • Equipment Maintenance 	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • apply safe work practices and procedures: <ul style="list-style-type: none"> – select and use appropriate personal protective equipment – maintain a clean and tidy work station – demonstrate safe tool/material handling and storage techniques • for a given type of weld and/or weldment, select the appropriate: <ul style="list-style-type: none"> – wire type, size and feed rate – current – shielding gas type and flow rate • prepare and clean all surfaces to be welded • properly position metal for welding • describe and demonstrate the maintenance required for wire drive systems and gun assemblies 	
<p>Implementation</p> <ul style="list-style-type: none"> • Flux Core Arc Welding 	<ul style="list-style-type: none"> • demonstrate safe FCAW techniques and perform fillet welds in the flat, horizontal and vertical positions on mild steel plate • demonstrate safe FCAW techniques and perform groove welds in the flat position on mild steel plate 	
<p>Assessment</p> <ul style="list-style-type: none"> • Quality Control • Career Preparation 	<ul style="list-style-type: none"> • complete a visual inspection (i.e., non-destructive test) by observing and assessing: <ul style="list-style-type: none"> – overall size, shape and appearance of the beads – plate penetration – fusion – degree of undercutting and overlapping • perform a destructive test where appropriate • prepare a record of completed activities within a portfolio 	