



## COURSE OUTLINE: MTF141 - MATERIALS/PROC QUAL

Prepared: Larry Canduro

Approved: Corey Meunier, Chair, Technology and Skilled Trades

<b>Course Code: Title</b>	MTF141: MATERIALS AND PROCESS QUALITY
<b>Program Number: Name</b>	4051: METAL FABRICATION 4053: WELDING TECHNIQUES
<b>Department:</b>	IRONWKR APPR./WELDING RELATED
<b>Semesters/Terms:</b>	22W
<b>Course Description:</b>	This course deals mainly with how metals are affected by welding. To be a competent welder, a good understanding of the materials being welded is needed as well as the processes and procedures required to produce sound, reliable welds. A thorough study of the mechanical and physical properties of metals is then followed by presentations that explain how metals are affected by forming and the application of welding heat. Safety precautions will be discussed, along with welding codes and standards. Topics range from Welding Metallurgy and Weldability of Metals to Testing and Inspection of Welds and Welder Certification.
<b>Total Credits:</b>	3
<b>Hours/Week:</b>	3
<b>Total Hours:</b>	45
<b>Prerequisites:</b>	There are no pre-requisites for this course.
<b>Corequisites:</b>	There are no co-requisites for this course.
<b>Vocational Learning Outcomes (VLO's) addressed in this course:</b>	<p><b>4051 - METAL FABRICATION</b></p> <p>VLO 5 Understand and use a variety of destructive and non-destructive methods to test welds.</p> <p>VLO 7 Complete all work in compliance with health and safety legislation and prescribed organizational practices and procedures to ensure safety of self and others.</p> <p><b>4053 - WELDING TECHNIQUES</b></p> <p>VLO 1 Perform work responsibly and in compliance with the Occupational Health and Safety Act.</p> <p>VLO 3 Recognize and understand use of welding symbols.</p> <p>VLO 9 Identify defect in welds, demonstrate how to prevent them and define procedures for correction of defective weld quality.</p>
<b>Essential Employability Skills (EES) addressed in this course:</b>	<p>EES 1 Communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.</p> <p>EES 2 Respond to written, spoken, or visual messages in a manner that ensures effective communication.</p> <p>EES 6 Locate, select, organize, and document information using appropriate technology and information systems.</p>

In response to public health requirements pertaining to the COVID19 pandemic, course delivery and assessment traditionally delivered in-class, may occur remotely either in whole or in part in the 2021-2022 academic year.



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	<p>EES 7 Analyze, evaluate, and apply relevant information from a variety of sources.</p> <p>EES 8 Show respect for the diverse opinions, values, belief systems, and contributions of others.</p> <p>EES 9 Interact with others in groups or teams that contribute to effective working relationships and the achievement of goals.</p> <p>EES 10 Manage the use of time and other resources to complete projects.</p> <p>EES 11 Take responsibility for ones own actions, decisions, and consequences.</p>
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<b>Course Evaluation:</b>	<p>Passing Grade: 50%, D</p> <p>A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation.</p>
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<b>Other Course Evaluation &amp; Assessment Requirements:</b>	<p>1.Late hand in penalties will be -10% per day.</p> <p>2.If a student misses a test, he/she must have a valid reason (i.e. medical or family emergency documentation shall be required). In addition, the instructor MUST be notified PRIOR to the test sitting. If this procedure is not followed the student will receive a mark of zero on the test with no make-up option.</p> <p>3.Re-writes are NOT allowed for any written assignment, quiz or test.</p> <p>4.Course attendance is mandatory. Any student that is not present for the first 3 classes in each course, will be deemed to have not completed the required safety orientation for the course and will not be permitted to continue. One percent (1 %) per hour will be deducted from the final course grade for unexcused* absence. Any unexcused attendance beyond 15% of the total allocated course hours will result in the student receiving a failing grade for the course.</p> <p>Valid reasons would include: Doctors note Family Death or Serious Illness supported by a written note.</p> <p>Unexcused absence* will be determined in a case by case basis by the instructor of each course.</p>
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<b>Books and Required Resources:</b>	<p>IPT's Metal Trades &amp; Welding Publisher: IPT Publishing &amp; Training Ltd</p> <p>Kit: ILM Post Secondary Package by Alberta Government Publisher: AK Graphics, Sault College Print Shop</p>
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<b>Course Outcomes and Learning Objectives:</b>	<table border="1"> <thead> <tr> <th>Course Outcome 1</th> <th>Learning Objectives for Course Outcome 1</th> </tr> </thead> <tbody> <tr> <td>Define metals, their properties, and how they are made.</td> <td>           Define the properties of metals and how they affect weldability:           <ul style="list-style-type: none"> <li>o Tensile strength</li> <li>o Impact strength</li> <li>o Hardness</li> <li>o Ductility</li> <li>o Chemical properties</li> <li>o Corrosion resistance</li> <li>o Alloys</li> </ul>           Review the iron-making and steel-making processes:           <ul style="list-style-type: none"> <li>o Blast furnace: pig iron and cast iron</li> </ul> </td> </tr> </tbody> </table>	Course Outcome 1	Learning Objectives for Course Outcome 1	Define metals, their properties, and how they are made.	Define the properties of metals and how they affect weldability: <ul style="list-style-type: none"> <li>o Tensile strength</li> <li>o Impact strength</li> <li>o Hardness</li> <li>o Ductility</li> <li>o Chemical properties</li> <li>o Corrosion resistance</li> <li>o Alloys</li> </ul> Review the iron-making and steel-making processes: <ul style="list-style-type: none"> <li>o Blast furnace: pig iron and cast iron</li> </ul>
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- o Steel refining furnaces: basic oxygen furnace and electric arc furnace
- o Material forming methods: wrought and cast metals
- o Casting and continuous casting methods
- o Structural shapes: HSS, plate, hot rolled and cold rolled

Discuss the significance of mechanical and physical properties of common metals:

- o Understand the crystalline structures of carbon steels
- o Carbon steel microstructures:
  - ? Ferrite
  - ? Pearlite
  - ? Martensite
  - ? Austenite

Stainless steels:

- ? Austenitic
- ? Martensitic
- ? Ferritic

Aluminum (alloys):

- ? Designation system

Explain the purpose and effects of heat-treatments on steel:

- o Annealing
- o Normalizing
- o Quenching
- o Hardening
- o Tempering
- o Stress relieving

Describe properties of metals and their effect on material selection, fabrication and welding considerations.

Physical properties:

- ? Mass
- ? Melting point
- ? Thermal conductivity
- ? Coefficient of expansion
- ? Electrical conductivity

Mechanical properties:

- ? Tensile strength
- ? Yield strength
- ? Ductility
- ? Impact strength

Identify steel types and classification systems:

Characteristics of:

- ? Low carbon steel
- ? Medium carbon steel
- ? High carbon steel

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	<p>? Stainless steel</p> <p>Classification numbering systems of plain carbon steels</p> <p>? SAE</p> <p>? AISI</p> <p>? ASTM</p> <p>? CSA</p> <p>Metal (steel) identification methods:</p> <p>? Appearance</p> <p>? Hardness test</p> <p>? Magnetic test</p> <p>? Chisel test</p> <p>? Fracture test</p> <p>? Flame test</p> <p>? Spark test</p> <p>? Weight test</p> <p>Identify factors affecting the formability and weldability of the following metals:</p> <ul style="list-style-type: none"> <li>o Carbon and low alloy steels</li> <li>o Stainless steels</li> <li>o Aluminum and aluminum alloys</li> <li>o Cast iron and non-ferrous metals</li> </ul>
<b>Course Outcome 2</b>	<b>Learning Objectives for Course Outcome 2</b>
Describe methods of distortion control.	<ul style="list-style-type: none"> <li>• Selection of preventative method</li> <li>• Preheating</li> <li>• Pre-setting joints</li> <li>• Jigs and fixtures</li> <li>• Effects of joint configuration, weld size, travel speed and multiple pass verses single pass</li> <li>• Perform correction of weld distortion</li> </ul>
<b>Course Outcome 3</b>	<b>Learning Objectives for Course Outcome 3</b>
Explain the function and application of destructive and non-destructive testing methods for welds.	<p>Explain the function and application of mechanical test methods:</p> <ul style="list-style-type: none"> <li>o Tensile testing</li> <li>o Impact testing</li> <li>o Bend testing</li> </ul> <p>Explain the function and application of non-destructive test methods:</p> <ul style="list-style-type: none"> <li>o Visual inspection</li> <li>o Penetrant testing</li> <li>o Magnetic particle testing</li> <li>o Radiography</li> <li>o Ultrasonic testing</li> </ul> <p>Describe inspection and testing methods:</p> <ul style="list-style-type: none"> <li>o Non-destructive testing</li> <li>o Destructive testing</li> </ul>

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	<ul style="list-style-type: none"> <li>o Hydrostatic testing</li> <li>o Leak testing</li> <li>o Vacuum testing</li> </ul>
<b>Course Outcome 4</b>	<b>Learning Objectives for Course Outcome 4</b>
Describe the requirements of welding codes and standards.	<p>Codes and standards related to structural steel construction:</p> <ul style="list-style-type: none"> <li>o CSA W47.1</li> <li>o CSA W59</li> </ul> <p>Codes and standards related to boilers and pressure vessels:</p> <ul style="list-style-type: none"> <li>o ASME Boiler and Pressure Vessel Code</li> <li>o CSA B51 Boiler, Pressure Vessel and Pressure Piping Code</li> </ul> <p>Codes and standards related to piping systems:</p> <ul style="list-style-type: none"> <li>o ASME B31 Code for Pressure Piping</li> <li>o CSA Standard Z662 Oil and Gas Pipeline Systems</li> </ul> <p>Codes and standards related to storage tanks:</p> <ul style="list-style-type: none"> <li>o API 650</li> </ul> <ul style="list-style-type: none"> <li>• CSA W48 Filler Metal Requirements</li> <li>• Explain the requirements for welding performance qualification testing</li> <li>• Explain the requirements for welding procedure qualification testing</li> </ul>
<b>Course Outcome 5</b>	<b>Learning Objectives for Course Outcome 5</b>
Describe the features of weld quality, welding discontinuity and welding procedures.	<ul style="list-style-type: none"> <li>• Define welding discontinuities and their effect on weld quality</li> <li>• Describe the need for other functions to assure weld quality</li> <li>• Define procedures for correction of defective weld quality</li> </ul>

<b>Evaluation Process and Grading System:</b>	<b>Evaluation Type</b>	<b>Evaluation Weight</b>
	Classroom Tasks	15%
	Shop Tasks	15%
	Theory Tests	70%

<b>Date:</b>	January 6, 2022
<b>Addendum:</b>	Please refer to the course outline addendum on the Learning Management System for further information.

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