COURSE OUTLINE: MTF102 - WELDING THEORY 1

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Course Code: Title	MTF102: WELDING THEORY 1
Program Number: Name	4051: METAL FABRICATION 4053: WELDING TECHNIQUES
Department:	IRONWKR APPR./WELDING RELATED
Academic Year:	2025-2026
Course Description:	Describe the functions and controls of welding power sources in accordance with government safety regulations, manufacturer recommendations and approved industry standards.
Total Credits:	3
Hours/Week:	3
Total Hours:	42
Prerequisites:	There are no pre-requisites for this course.
Corequisites:	There are no co-requisites for this course.
Vocational Learning Outcomes (VLO's) addressed in this course: **Please refer to program web page for a complete listing of program outcomes where applicable.**	**4051 - METAL FABRICATION** VLO 2 Apply knowledge of various welding and metal cutting techniques and theories to produce components and sub-assemblies. VLO 5 Understand and use a variety of destructive and non-destructive methods to test welds. 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. **4053 - WELDING TECHNIQUES** VLO 1 Perform work responsibly and in compliance with the Occupational Health and Safety Act. VLO 3 Recognize and understand use of welding symbols. VLO 9 Identify defect in welds, demonstrate how to prevent them and define procedures for correction of defective weld quality.
Essential Employability Skills (EES) addressed in this course:	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. EES 2 Respond to written, spoken, or visual messages in a manner that ensures effective communication. EES 6 Locate, select, organize, and document information using appropriate technology and information systems. EES 7 Analyze, evaluate, and apply relevant information from a variety of sources. EES 8 Show respect for the diverse opinions, values, belief systems, and contributions of others.

	EES 9 Interact with others in groups or teams that contribute to effective working relationships and the achievement of goals. EES 10 Manage the use of time and other resources to complete projects. EES 11 Take responsibility for ones own actions, decisions, and consequences.
Course Evaluation:	Passing Grade: 50%, D A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation.
Other Course Evaluation & Assessment Requirements:	1.Late hand in penalties will be -10% per day. 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. 3.Re-writes are NOT allowed for any written assignment, quiz or test. 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. Valid reasons would include: Doctors note Family Death or Serious Illness supported by a written note. Unexcused absence* will be determined in a case by case basis by the instructor of each course.
Books and Required Resources:	CWB Post Secondary Package by CWB Education Publisher: CWB Group IPT`s Guide To Blueprint Interpretation by Grant E. Jacobs Publisher: IPT Publishing & Training Ltd.

Course Outcomes and Learning Objectives:

Course Outcome 1	Learning Objectives for Course Outcome 1
Upon successful completion of this course, the student will demonstrate the ability to: Define the functions of welding power sources. Describe the effects of power source controls on welding processes. Define the fundamentals of the Shielded Metal Arc Welding (SMAW) process. Describe the equipment requirements for the	1. Power Sources Potential Elements of the Performance: Define the functions of welding power sources. constant current constant voltage inverters transformers transformer rectifiers generators engine drives amperage controls principle of inductance tapped control saturable reactor

	Shielded Metal Arc Welding (SMAW) process. Describe the construction and characteristics of Shielded Metal Arc Welding (SMAW) electrodes. Describe the Shielded Metal Arc Welding (SMAW) procedure variables and their effects on quality and productivity. Define the fundamentals of the Gas Metal Arc Welding (GMAW) process. Explain safety concerns applicable to the Gas Metal Arc Welding (GMAW) process. Explain the function of the components of the Gas Metal Arc Welding (GMAW) process. Explain the selection and characteristics of consumables necessary for Gas Metal Arc Welding (GMAW) short-circuit transfer and spray-arc transfer. Describe the procedure variables for Gas Metal Arc Welding (GMAW) and their affect on quality and productivity. Define the fundamentals of the Flux Cored Arc Welding (FCAW) process and Metal Cored Arc Welding (MCAW) process. Explain the function of the components of the Flux Cored Arc Welding (FCAW) process and Metal Cored Arc Welding (MCAW) process. Describe the selection of welding parameters and consumables necessary for Flux Cored Arc Welding (FCAW) and Metal Cored Arc Welding (MCAW).	shunt magnetic amplifier SCR Describe the effects of power source controls on welding processes. amperage voltage voltage trim remote controls output characteristics current type polarity slope control inductance square wave high frequency AC balance transformer rectifier inverter welding current output frequency inverter controls 2. Shielded Metal Arc Welding Potential Elements of the Performance: Define the fundamentals of the Shielded Metal Arc Welding (SMAW) process. development of arc welding method of melting and freezing fusion arc characteristics arc length effect on voltage penetration travel speed optimum effects of too fast or too slow weld contamination protection Describe the equipment requirements for the Shielded Metal Arc Welding (SMAW) process. power sources - transformers - rectifiers - inverters - generators - engine driven - power source controls - amperage - duty cycle - voltage - current type - polarity

	Define the fundamentals of the Gas Tungsten Arc Welding (GTAW) process. Explain the safety concerns applicable to the Gas Tungsten Arc Welding (GTAW) process. Describe the required equipment and components for the Gas Tungsten Arc Welding (GTAW) process. Explain the characteristics and selection considerations for consumables used for Gas Tungsten Arc Welding (GTAW) on steel. Explain the set-up and control of the process variables for the Gas Tungsten Arc Welding process.	- arc force - electrode holders - clamp - jaw types - welding cables - cable size and condition - connectors - relationship to required amperage - work lead - completion of welding circuit - clamps in good repair - work lead locations Describe the construction and characteristics of Shielded Metal Arc Welding (SMAW) electrodes - basic construction features - core wire - flux covering - manufacturing methods of welding electrodes - electrode concentricity - functions of the flux coating - flux coating base material - chemical properties and alloying elements - shielding - classification of Shielded Metal Arc Welding (SMAW) electrodes, CSA and AWS. - low hydrogen (basic) - cellulose - rutile - iron powder - mild steel - low alloy - stainless steel - meaning of each letter and numerical group - imperial and metric versions - storage and handling - electrode conditioning - storage temperatures Describe the Shielded Metal Arc Welding (SMAW) procedure variables and their effect on quality and productivity. - primary variables (conducted prior to welding) - joint design and fit-up - consumables - current type and polarity - amperage - pre-heat - electrode size - secondary variables (conducted during welding) - travel speed - arc length - work angle - electrode angle - technique - whipping

		- weaving - stringer - multiple passes - drag 3. Gas Metal Arc Welding Potential Elements of the Performance: Define the fundamentals of the Gas Metal Arc Welding (GMAW) process. - modes of metal transfer - short-circuiting transfer - spray arc transfer - globular - pulsed - gas shielding - purpose - types - Argon / Helium - CO2 - mixed gases - triple mix gas Explain safety concerns applicable to the Gas Metal Arc Welding (GMAW) process. - UV radiation protection - appropriate helmet and filter plate - spatter and proper safety clothing - storage and handling of high pressure cylinders - flow meters - fumes and gases - oxygen depletion Explain the function of the components of the Gas Metal Arc Welding (GMAW) process. - fundamentals and characteristics of the Constant Voltage power source - self- correcting arc gap - application of Constant Current power sources - wire feeders - spool guns - push type - push-pull type - drive rolls - liners - metallic - non-metallic - gas diffusers - contact tips / contact tubes - nozzles - water cooled guns - radiation - Ultra Violet - Infra Red - white light - noise - fall protection - falling objects Explain the selection and characteristics of consumables necessary for Gas Metal Arc Welding (GMAW) short-circuit transfer and spray-arc transfer.

- optimal wire type and size (diameter)
- filler metal classification system
- low alloy
- steels
- stainless steels
- aluminum
- types and sizes
- purpose of copper plating
- shielding gas
- types
- flow rate

Describe the procedure variables for Gas Metal Arc Welding (GMAW) and their affect on quality and productivity.
- primary variables (conducted prior to welding)
- joint design and fit-up
- consumables
- shielding gas
- current type and polarity
- amperage
- wire feed speed
- wire diameter
- voltage
- preheat
- secondary variables (conducted during welding)
- travel speed
- nozzle to work distance
- work angle
- gun angle to work
- technique
- stringer
- multi-passes
- weaving
- forehand
- backhand

4. Flux Core/Metal Core Arc Welding
Potential Elements of the Performance:
Define the fundamentals of the Flux Cored Arc Welding (FCAW) process and Metal Cored Arc Welding (MCAW) process.
- metallic transfer
- construction of the tubular wire
- wire types
- flux types
- gas shielding
- purpose
- types

Explain the function of the components of the Flux Cored Arc

		Welding (FCAW) process and Metal Cored Arc Welding (MCAW) process. - fundamentals and characteristics of the Constant Current power source - fundamentals and characteristics of the Constant Voltage power source - electrode wire classification - types and sizes - mechanical feeders - drive rolls - liners - contact tips - nozzles - gas shielding - gas diffusers Describe the selection of welding parameters and consumables necessary for Flux Cored Arc Welding (FCAW) and Metal Cored Arc Welding (MCAW). - material thickness - position of welding - voltage - wire feed speed - wire type and size - drive rolls - contact tips - selection of shielding gas - types - flow rate - gun angle - direction of travel 5. Gas Tungsten Arc Welding Potential Elements of the Performance: Define the fundamentals of the Gas Tungsten Arc Welding (GTAW) process. - non-consumable tungsten electrode - gas shielding of weld - advantages of the Gas Tungsten Arc Welding (GTAW) process - no spatter - all position capable - precision - weld light gauge materials - high quality welds - concentrated high-temperature arc - wide variety of applications and alloys - limitations of the Gas Tungsten Arc Welding (GTAW) process - deposition rates - pre-cleaning required Explain the safety concerns applicable to the Gas Tungsten Arc Welding (GTAW) process. - arc radiation - heat - air quality

	- fumes - gases - oxygen depletion - electrical - high frequency - thorium - high pressure cylinders Describe the required equipment and components for the Gas Tungsten Arc Welding (GTAW) process. - power source - fundamentals and characteristics of the constant current power source -equipment controls -welding currents -AC -DC electrode negative -DC electrode positive -high frequency (HF) circuit - contactor and current control methods manual control - remote controls - foot control - torch thumbwheel - shielding gas supply system - cylinders or bulk systems - regulator - flow meter - hoses - torches - air and water cooled - amperage rating - coolant circulators - collet and body - nozzle - gas lens Explain the characteristics and selection considerations for consumables used for Gas Tungsten Arc Welding (GTAW) on steel. - shielding gas - type - flow rate (imperial and metric) - filler material - type (alloy) and classification - size - tungsten electrode - type and grade - size conditioning and contamination control

Evaluation Process and Grading System:

Evaluation Type	Evaluation Weight
Test 4	20%
Test 1	20%
Test 2	20%
Test 3	20%
Test 5	20%

Date:	July 9, 2025
Addendum:	Please refer to the course outline addendum on the Learning Management System for further information.