LAKELAND COMMUNITY COLLEGE – COURSE OUTLINE FORM*

*** WORK-IN-PROCESS VERSION, NOT YET APPROVED ***

ORIGINATION DATE:	8/10/17	**APPROVAL DATE:**	
LAST MODIFICATION DATE:	11/16/17	**EFFECTIVE TERM/YEAR:**	FALL/ 18
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COURSE ID: **WELD2350**

COURSE TITLE: Advanced GMAW (MIG/MAG) Welding

	LECTURE	LAB	CLINICAL	TOTAL	OBR MIN	OBR MAX
CREDITS:	1.00	2.00	0.00	3.00	0.00	3.00
CONTACT HOURS:	1.00	4.00	0.00	5.00		

PREREQUISITE:

WELD 1040 (can be taken concurrently), WELD 1340; or permission of instructor

COURSE DESCRIPTION:

This course introduces students to advanced concepts relating to the use of the Gas Metal Arc Welding (GMAW) (MIG/MAG) process to make high quality, cost-efficient fillet and groove welds in the vertical and overhead positions in steel, aluminum, and stainless steel. It involves the use of advanced manipulative techniques, and utilizing variations of the process such as short-circuiting and spray transfer, pulsed-arc, and modified current wave-forms generated by advanced inverter types of welding power sources. Safety is emphasized and the additional concerns associated with vertical and overhead welding are explained. Project Based Learning (PBL) is utilized to familiarize students with being part of a team that takes an idea for a product, designs it, and makes it a reality. At the conclusion of this course, students take either a 3G or 4G pass/fail welder qualification test using the GMAW process. An Industry Recognized Certification of Qualification will be awarded to students passing the test. The student must furnish: welding helmet (shade #10 or above); safety glasses; work gloves; long pants; welding jacket; leather work boots, preferably steel toe; 8” crescent wrench; soapstone and holder; tape measure; combination square; chipping hammer; wire brush; tool bag; center punch; and 12 oz. ball peen hammer. 4 1/2” grinder is optional.

RATIONALE FOR COURSE:

This course provides practical welding experience and knowledge for students wanting to gain an in-depth understanding of the GMAW (MIG/MAG) process and use it, and variations of it, to make fillet and groove welds in the vertical and overhead positions in steel, stainless steel and aluminum. This course will provide a pathway for employment in a welding field and for welding certification.

OUTCOMES:

The course will

1. Reinforce students understanding of essential welding safety equipment and procedures.

2. Provide instruction and familiarize students with how to set-up, trouble shoot and properly adjust GMAW equipment, and to select the proper shielding gas and electrode for use in specific situations.

3. Provide instruction and give students hands-on experience using the GMAW process and proper electrode manipulative techniques to safely produce high quality, cost effective fillet and groove welds in the vertical and overhead positions in steel, stainless steel and aluminum.

4. Introduce students to the metallurgy of welding by providing them with an understanding of the nature and characteristics of the base metals and electrodes, and how the base materials are affected by welding.

5. Enable students to recognize both the benefits and disadvantages of using the GMAW welding process in its various modes of metal transfer, when pulsed or with an advanced inverter power source providing waveform control technology.

6. Develop students' ability to evaluate welds for quality and determine if they are acceptable by referring to an appropriate code or standard.

7. Introduce students to basic concepts involved in teamwork, reading shop drawings, performing lay-out and fitting operations, and selecting appropriate weld joints for use in various types of situations.

8. Provide instruction in the various tests and examinations associated with the qualification of a welder per the American Welding Society (AWS) D1.1 code.

PERFORMANCE INDICATORS:

Upon completion of the course, the student should be able to

1. Identify, understand and work in accordance with applicable safety procedures when using welding or welding-related equipment, or whenever in a metal fabricating or manufacturing facility or on a construction worksite.

2. Use the GMAW process to produce acceptable fillet and groove welds in the vertical and horizontal positions in carbon steel, stainless steel and aluminum sheets and plates, structural shapes and pipe and tube.

3. Describe the major components and functionality of both traditional and newer types of power sources and related equipment used for GMAW welding.

4. Demonstrate proficiency using the GMAW process in the 3G and/or 4G positions by welding a test plate that meets the visual examination and bend test performance requirements of the AWS D1.1. Structural Welding Code. The bend specimens will be as taken from the plates, prepared by and tested by the Instructor.

COURSE OUTLINE:

I. Safety and Health
   A. Personal protective equipment (PPE)
   B. General safety and health concerns not specifically related to welding

II. Safety and Health
   A. Personal protective equipment (PPE)
   B. General safety and health concerns not specifically related to welding
   C. Safety and health concerns associated with welding

D. Additional concerns when making fillet and groove welds in the vertical and overhead positions
    1. Protection from falling sparks and molten metal
    2. Special positioning necessary for head and body
    3. Additional protective clothing required
    4. Ear plugs necessary to protect ear canal from sparks, slag, etc.

III. GMAW-Fundamentals
A. Three types of GMAW processes and four modes of metal transfer
    1. Conventional GMAW (Spray, short-arc, globular and dip-transfer)
    1. Pulsed-arc (GMAW-P)
    2. Modified with waveform control (Lincoln STT, Miller RMD, etc.)
    3. All three are used to make vertical and overhead welds
    4. Special attention needed when making fillet and groove welds in the vertical and overhead positions
        a. Selection of type GMAW process and mode of metal transfer
        b. Gas selection
        c. Weave patterns and manipulative techniques
        d. Special body and head positioning
B. Equipment required for making fillet and groove welds in the vertical and overhead positions
    1. Power sources, wire feeders, gas control devices, welding guns
    2. Sources of shielding gas for weld pool
        a. GMAW-S: CO_2 or Argon/CO_2 blend, and TRI MIX AR/CO_2/HE
        b. GMAW-P: Argon/CO_2 blend with CO_2 > 80%
        c. STT, RMD, etc.: CO_2, Argon/CO_2 Blend, and TRI MIX (AR/CO_2/HE)

IV. Advantages of GMAW Processes when Used to Make fillet and groove welds in the vertical and overhead positons
A. Deposition rates are high compared to GTAW and SMAW
B. Essentially no slag to be removed
C. Operator usability

V. Disadvantages of GMAW
A. Shielding gas is required
B. Not as high a deposition rate as FCAW for steel and stainless steel

VI. Proper Welding Techniques For Making fillet and groove welds in the vertical and overhead positions
A. Set up of equipment
B. Selection of electrodes and shielding gas
    1. Must consider properties, position, number of passes, shielding gas
C. Understanding and utilizing the Welding Procedure Specification (WPS)
D. Determining weld bead locations and deposition sequence
E. Use of weaving patterns (if any required)
F. Must properly control the five critical manipulative variables
G. Must “Read” and control molten weld pool by adjusting the five critical manipulative variables

VII. Impact of Making fillet and groove welds in the vertical and overhead positions on Productivity
A. Must adjust several variables in ways that result in less productivity
    1. More difficult to make so harder to avoid over-welding
    2. Wire feed rates cannot be as high - but keep as high as possible
    3. Maximizing arc-on time still important
    4. Minimizing motion and delay times still important
    5. Avoiding repairs, rework and scrap (Important -but harder to do)

VIII. Visual Examination of Welds to Determine Quality and Acceptability
A. Must have a code or standard of acceptance

B. Types of Defects
    1. Dimensional
    2. Discontinuities
    3. Other
C. Determined to be acceptable or unacceptable based on measuring
D. Measured using gauges and instruments

IX. Troubleshooting to Prevent Weld Defects
A. Machine settings or poorly-written WPS
B. Defective equipment or variations in power coming to equipment
C. Wrong, out-of-spec, or improperly prepared base material or consumables
D. Welding environment (drafty or wet)
E. Poor fit-up
F. Not adhering to WPS
G. Not properly controlling the five critical manipulative variables

X. Project Experience – Steel Fabrication Using the GMAW Process
A. Students given basic information necessary to undertake project
    1. Purpose or function of the project
    2. Resources available
    3. Completion date
B. Development of project plan, specifications and schedule
C. Design of project
    1. Conceptual and preliminary designs and drawings
    2. Design review
    3. Final design drawings
    4. Acceptance of final design
D. Construction or fabrication
    1. Ordering materials and parts fabrication
    2. Subassembly fabrication
    3. Final assembly or erection
E. Testing, inspection and acceptance

XI. Welder Qualification Test
A. Hands-on skills test of student's ability to make acceptable GMAW or GMAW-P welds
    1. Can make either 3G or 4G welds using either GMAW or GMAW-P
    2. Pass/fail test
    3. Industry Recognized Certification of Qualification is awarded to students passing independent 3rd party test of welds made using a qualified or pre-qualified Welding Procedure Specification

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INSTRUCTIONAL PROCEDURES THAT MAY BE UTILIZED:

Lectures, Project Based Learning, videos, online resources or handouts may be used for instruction of the fundamental concepts. Students set up and practice welding using various types of welding equipment during laboratory.

GRADING PROCEDURES:

Examinations and/or quizzes
Class participation and discussion
Lab work, individual projects, papers or reports and/or
Homework

COURSE EVALUATION PROCEDURES:

This course will be reviewed bi-annually by faculty and the Advisory Committee. Students will complete course evaluations each semester.

See pages 17-19 of Curriculum Procedures & Guidelines for definitions of course outline terms.

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LAKELAND STUDENT LEARNING OUTCOMES

		I	R	D
	LEARNS ACTIVELY			
1.	Takes responsibility for his/her own learning.			
2.	Uses effective learning strategies.			
3.	Reflects on effectiveness of his/her own learning strategies.			
	THINKS CRITICALLY	**I**	**R**	**D**
4.	Identifies an issue or idea.			
5.	Explores perspectives relevant to an issue or idea.			
6a.	Identifies options or positions.			D
6b.	Critiques options or positions.			
7.	Selects an option or position.			D
8a.	Implements a selected option or position.			D
8b.	Reflects on a selected option or position.			
	COMMUNICATES CLEARLY	**I**	**R**	**D**
9a.	Uses correct spoken English.			
9b.	Uses correct written English.			
10.	Conveys a clear purpose.			
11.	Presents ideas logically.			D
12a.	Comprehends the appropriate form(s) of expression.			D
12b.	Uses the appropriate form(s) of expression.			D
13.	Engages in an exchange of ideas.			
	USES INFORMATION EFFECTIVELY	**I**	**R**	**D**
14.	Develops an effective search strategy.			
15a.	Uses technology to access information.			
15b.	Uses technology to manage information.			
16.	Uses selection criteria to choose appropriate information.			
17.	Uses information responsibly.			
	INTERACTS IN DIVERSE ENVIRONMENTS	**I**	**R**	**D**
18a.	Demonstrates knowledge of diverse ideas.			
18b.	Demonstrates knowledge of diverse values.			
19.	Describes ways in which issues are embedded in relevant contexts.			
20a.	Collaborates with others.			
20b.	Collaborates with others in a variety of situations.			
21.	Acts with respect for others.			

Definitions:

Introduces (I)

Students first learn about key ideas, concepts, or skills related to the performance indicator. This usually happens at a general or very basic level, such as learning one idea or concept related to the broader outcome.

Reinforces (R)

Students are given the opportunity to synthesize key ideas of skills related to the performance indicator at increasingly proficient levels.

Demonstrates (D)

Students should demonstrate mastery of the performance indicator with the level of independence expected of a student attaining an associate's degree.