LAKELAND COMMUNITY COLLEGE – COURSE OUTLINE FORM

*** APPROVED VERSION, EFFECTIVE Fall/ 18

ORIGINATION DATE:	8/2/99	**APPROVAL DATE:**	12/5/17
LAST MODIFICATION DATE:	1/23/18	**EFFECTIVE TERM/YEAR:**	FALL/ 18
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COURSE ID: **WELD1320**

COURSE TITLE: Basic SMAW (Stick) Welding

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

PREREQUISITE:

WELD 1030 (can be taken concurrently)

COURSE DESCRIPTION:

This course introduces students to Shielded Metal Arc Welding (SMAW) of carbon steel. Laboratory experience develops the skill to produce acceptable fillet and grove welds in the flat and horizontal positions, and includes functions and specific uses of manual welding equipment, various SMAW (Stick) welding techniques, special metals handling, and welding certification requirements. Students must furnish: welding helmet (shade #10 or above); safety glasses; work gloves; long pants; welding jacket; leather work boots, preferable steel toe; 8" crescent wrench; soapstone and holder; tape measure; combination square; chipping hammer; wire brush; center punch; 12 oz. ball peen hammer; and tool bag. 4 1/2" grinder is optional.

RATIONALE FOR COURSE:

This course is designed to introduce students to SMAW (Stick) Welding in the flat and horizontal positions.

OUTCOMES:

The course will:

1. Introduce students to essential welding safety equipment and procedures.

2. Enable students to recognize an acceptable weld that is properly produced using various techniques utilized with the flat and horizontal positions, the electrodes used, and the safety techniques involved.

3. Introduce instruction in the various power sources and machine settings required to make welds in the flat and horizontal positions.

4. Introduce students to the mechanical properties of a weld, including tensile and yield strength, toughness, per cent reduction of area, and per cent elongation.

5. Introduce instruction in how voltage and amps relate to the welding arc.

6. Introduce instruction in how industry uses American Welding Society (AWS) numbering systems.

7. Provide students with experience in SMAW arc welding in the flat and horizontal positions.

PERFORMANCE INDICATORS:

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

1. Identify and apply safety procedures when working with welding equipment.

2. Make an acceptable weld (one that meets the visual quality requirements of AWS D1.1) in 12-gage or thicker plate using E6010 electrodes.

3. Make an acceptable weld in 12-gage or thicker plate using E7018 electrodes.

4. Properly set the machine controls for the transformer, rectifier, and motor generator power sources for specific welding tasks.

5. Use the SMAW process and E6010 and E7018 electrodes to produce acceptable flat and horizontal fillet, lap and butt welds.

6. Produce acceptable vertical down t-joint and lap welds using E6010 and E6011 electrodes.

7. Describe the qualification tests as used by AWS and American Society of Mechanical Engineers (ASME) to qualify welders for making welds in the 1F, 2F, 1G and 2G positions, and demonstrate the proper welding techniques according to the respective codes.

8. Demonstrate the difference between T-joint, lap, corner, edge, and butt welds.

COURSE OUTLINE:

I. Introduction to Shielded Metal Arc Welding
   - A. Safety
     1. Personal Protective equipment
     2. Fumes and gases
     3. Electric shock can kill
     4. Burns
     5. UV and IR rays
   - B. Overview of the SMAW process
     1. How an SMAW weld is made
        - a. Definition of a weld
        - b. Heat for melting metal produced by an electric arc
        - c. Parts of a weld
     2. Equipment
        - a. Power source
        - b. Welding leads and connectors
        - c. Electrode
        - d. Electrode holder

II. Power Sources and Basic Electricity as Related to Welding
   - A. Types of power sources used for welding
     1. Constant Current
        - a. SMAW, GTAW and Sub Arc
     2. Constant Voltage
        - a. GMAW and FCAW
     3. Transformer
        - a. Home owners AC input current
     4. Transformer Rectifier
        - a. Rectifier= and electrical device that will change AC current into DC current
     5. DC Motor generator

a. Portable delivers only DC current
6. Inverter
a. Light weight, energy efficient, portable and smaller
7. Rectified alternator
a. Engine driven AC DC polarity
B. Duty Cycle
1. Percentage of a 10 minute period that a welder can operate at a given current output setting
C. Polarity
1. Direction of current flow
a. DC+ max. penetration min. build up
b. DC- max. build up min. penetration
c. AC 50% build up 50% penetration
2. All electrodes will weld on DC some will Weld on AC
D. Open Circuit Voltage
1. OCV
a. Voltage at the output terminals of a welding machine when it energized and current is not being drawn.
E. Factors that determine the current used for welding
1. Thickness of the plate
2. Diameter of the electrode
3. Position of plate

III. Electrodes
A. Purpose of the coating of the electrode
1. Shields the puddle from the atmosphere
a. atmosphere: 78% nitrogen, 21% Oxygen, .93%Argon and .07% Miscellaneous
2. Stabilizes the arc
3. Slows the cooling rate of the weld
B. AWS numbering system for mild steel electrodes
1. E6010
a. E=Electrode
b. 60x1000=60,000 Minimum tensile strength
c. 1=all 2=flat and horizontal
d. Last two numbers together represent group and coating
C. The Electrode Groups
1. Fill-freeze
2. Fast-freeze
3. Low hydrogen
4. Fast fill
D. Low hydrogen group LH
1. Most be stored in a rod oven
a. 250 Degrees 300 Degrees
2. H4R
a. 4 ml. of Hydrogen per 100 grams of weld metal
b. R = moisture resistance up to 9 hours
c. Heavy sections of steel 5/8 or greater

IV. Weld Joints and General Requirements of A Weld
A. Types of weld joints
B. Different parts of a weld
1. Legs of a weld
2. Toes of a weld
3. Face
4. Throat
5. Root
6. Root penetration\
C. Welding objectives
1. Flat face
a. Rod angles for single and multi-pass welds
i. 45 degrees
ii. 60 degrees

iii. 30 Degrees
2. Proper placement
a. Coverage
i. 1st pass even in the corner
ii. 2nd pass cover 1st pass 75 to 90%
iii. 3rd pass cover 2nd pass 50%
3. Fairly uniform
a. Technique
b. 6010 and 11
i. Whip rod and stack ripples
c. All other electrodes we drag
4. Good wash-in and avoidance of "rollover"
a. Undercut (concave)
i. too hot
ii. too fast
iii. undercut on one plate not the other wrong rod angle.

D. Mechanical properties
1. Tensile strength = breaking point
2. Yield strength = permanent deformation
3. Ductility = ability for material to stretch
4. Hardness = to resist indentation and or penetration
5. Toughness = Impact strength = energy absorbed when broken
a. CVN = Charpy V-notch test values, measured in ft-lb.

E. Introduction to Welding Procedure Specifications, welder qualification and other documentation

F. Introduction to weld quality inspection methods and acceptance standards

V. Manipulative Variables and Techniques for Producing Fillet and Groove Welds in the Flat and Horizontal Positions

A. Manipulative variables that must be adhered to when welding:
1. Travel speed
2. Travel angle
3. Transverse (work) angel
4. Tip to work distance
5. Tip location

B. Manipulative techniques
1. Drag
2. Whip

C. Techniques for starting and stopping welds

D. Arc blow
1. Arc blow is a phenomenon encountered in DC welding current where the magnetic field does not fallow the shortest path
a. Occurs beginning and end of the plates

E. Vertical up vs vertical down
1. 1/4" rule
a. 1/4" and thicker vertical Up
b. 1/4" and thinner vertical Down

INSTRUCTIONAL PROCEDURES THAT MAY BE UTILIZED:

Lectures, 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.

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LAKELAND STUDENT LEARNING OUTCOMES

		I	R	D
	LEARNS ACTIVELY			
1.	Takes responsibility for his/her own learning.			D
2.	Uses effective learning strategies.			D
3.	Reflects on effectiveness of his/her own learning strategies.			
	THINKS CRITICALLY	**I**	**R**	**D**
4.	Identifies an issue or idea.			D
5.	Explores perspectives relevant to an issue or idea.			
6a.	Identifies options or positions.			
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.			
12a.	Comprehends the appropriate form(s) of expression.			
12b.	Uses the appropriate form(s) of expression.			
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.			D
15b.	Uses technology to manage information.			D
16.	Uses selection criteria to choose appropriate information.			D
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.