

# Lakeland Community College COURSE SYLLABUS

## WELD 2340 Advanced FCAW (Flux Cored) Welding 3 credits

Lecture

Lab

**Instructor:** NAME OF INSTRUCTOR

**Contact:** Email:                   alternate:

**Phone:** cell: alternate:

### Textbook Required:

### HELP/TUTORING:

Available at the Learning Center Office, Rm A1044 Phone 525-7019

### COURSE DESCRIPTION:

This course introduces students to advanced concepts relating to the use of the Flux Cored Arc Welding (FCAW) Self Shielded (S) and Gas Shielded (G) welding processes to make high quality, cost-effective fillet and groove in the vertical and overhead positions in steel and stainless steel. Making such welds involves the use of advanced manipulative techniques that are more difficult to master than those used in WELD 1340. Safety is emphasized and the additional safety 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 either the FCAW-G or FCAW-S 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 both the FCAW-S and FCAW-G processes and use them to make fillet and groove welds in the vertical and overhead positions in steel and stainless steel. This course will provide a pathway for employment in a welding field and for welding certification.

### COURSE OBJECTIVES, at the conclusion of this course, the student should be able to:

1. Identify, understand and work in accordance with applicable safety procedures when using welding, welding-related equipment, whenever in a metal fabricating, or manufacturing facility, or on a construction worksite.
2. Use both the FCAW-G and FCAW-S welding processes to produce acceptable fillet and groove welds in the vertical and overhead positions in carbon steel and stainless steel plates, structural shapes, pipe and tube.
3. Describe the major components and functionality of both traditional and newer types of power sources and related equipment used for FCAW welding.
4. Demonstrate proficiency using the FCAW-G and FCAW-S processes in the 3G and/or 4G positions by welding test plates that meet 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 and tested by the Instructor.

## COURSE OUTLINE

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### I. 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 vertical and overhead welds
  - 1. Protection from falling sparks, slag 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.

### II. FCAW-Fundamentals

- A. Two Types of FCAW process
  - 1. Self-shielded (FCAW-S)
  - 2. Gas-shielded (FCAW-G)
  - 3. Both used to make vertical and overhead welds
  - 4. Special attention required if making vertical and overhead welds
    - a. Electrode selection
    - b. Polarity selection
    - c. Weave patterns and manipulative techniques
    - d. Special body and head positioning
- B. Equipment and Consumables used for making vertical and overhead welds
  - a. Power Sources, Wire Feeders and Welding Guns
    - a. Pulsing and waveform control technology often utilized in advanced welding, especially for 3F, 4F, 3G and 4G
    - b. Otherwise no special requirements
  - b. Electrodes:
    - a. Tubular flux-filled metal wire
    - b. Criteria for electrode selection & AWS numbering system
      - 1. Position of weld
      - 2. Required mechanical properties
      - 3. Type of shielding gas used
      - 4. number of passes in weld - single or multiple
    - c. Polarity sensitive
      - i. FCAW-S = DC-, DC+ or both; FCAW-G = typically DC+
    - d. Core elements for steel
      - i. include aluminum, calcium and carbon
  - c. Sources of shielding gas for weld pool
    - a. FCAW-S and FCAW-G: From vaporization of flux in the electrode
    - b. FCAW-G: Also from gas cylinders or an in-plant delivery system
    - c. FCAW-G shielding gases: Either 100%CO<sub>2</sub> or Argon/CO<sub>2</sub> mix
  - d. Gas control devices (Only for FCAW-G):
    - a. Regulator (psi)
    - b. Flow meter or constrictor in gas delivery system
      - 1. (cfh and scfh)

### III. Advantages of FCAW Processes When Used To Make Fillet and Groove Welds in the Vertical and Overhead Positions.

- A. Flux forms a slag that acts like a dam and holds molten metal in place when making vertical, horizontal and overhead welds
- B. FCAW-S can be used for outdoor welding or indoors in strong drafts
- C. No shielding gas required for FCAW-S
- D. FCAW deposition rates are very high

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IV. Disadvantages of FCAW

- A. More smoke and fumes than most other processes (FCAW-S = most)
- B. Spatter
- C. Slag has to be removed

V. Proper Welding Techniques for Making Vertical and Overhead Welds

- A. Set up of equipment
- B. Selection of electrodes and shielding gas
  - 1. Must consider properties, position, number of passes, and shielding gas (when selecting electrode)
- 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 use the proper five critical manipulative variables
- G. Must "read" and control molten weld pool by adjusting five variables

VI. Impact of Making Vertical and Horizontal Welds on Welding Productivity

- A. Must make adjustments to several of the five keys to 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)

VII. 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

VIII. Troubleshooting to Prevent Weld Defects

- A. Machine settings or poorly-written Welding Procedure Specification (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

IX. Project Experience - Steel Fabrication Using the FCAW Process

- A. Students given basic information necessary to undertake project
  - 1. Purpose or function of the project
    - 1. Resources available
    - 2. Completion date
- B. Development of project plan, specifications and schedule
- C. Design of project
  - 1. Conceptual and preliminary designs and drawings
    - 1. Design review
    - 2. Final design drawings
    - 3. Acceptance of final design
- D. Construction or fabrication
  - 1. Ordering materials and parts fabrication
  - 2. Subassembly fabrication
  - 3. Final assembly or erection

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E. Testing, inspection and acceptance

X. Welder Qualification Test

- A. Hands-on skills test of student's ability to make acceptable FCAW weld
1. Can make either 3G or 4G welds using either FCAW-G or FCAW-S
  2. Pass/fail test
  3. Industry recognized certification of qualification is awarded to students passing independent 3<sup>rd</sup> party testing of welds made using a qualified or pre-qualified Welding Procedure Specification.
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#### FEDERAL CREDIT COMPLIANCE STATEMENT:

It is expected that students will spend two to three hours, minimally, outside of the classroom/laboratory performing course related work such as reading, research, homework assignments, practice, studio work, and other academic work for every hour of instruction spent in the classroom/laboratory.

#### STUDENTS WITH DOCUMENTED DISABILITIES:

Lakeland Community College is committed to providing all students equal access to learning opportunities. The Student Accommodation Center works with students with documented disabilities to provide and/or arrange reasonable accommodations. If you have a disability (e.g. learning, attention, psychiatric, vision, hearing, physical, or systemic) and feel it may create a barrier to your education, contact the Student Accommodation Center at 440-525-7020 or stop by the office, Room A-1042.

#### SUBSTANCE ABUSE NOTICE:

The Lakeland Community College Welding Program is committed to a safe learning environment in the classroom and the laboratory. Students are expected to report to lecture and lab classes properly prepared and unimpaired by alcohol and/or drugs. If the instructor believes a student is under the influence of alcohol and/or drugs, the instructor will ask the student to leave the classroom to ensure the health and safety of all students. Any student asked to leave the classroom faces potential Student Conduct Code charges.

#### ACADEMIC INTEGRITY:

Honesty, as the basic component of trust is essential to both individual and institutional integrity. With this premise in mind, Lakeland Community College has set forth certain behaviors as being forms of academic misconduct, and thus potentially diminishing Lakeland's integrity, reputation for academic quality, and ability to function as an academic community. The institution's faculty and administration, therefore, regard academic misconduct as a serious offense. Established as violations of academic misconduct at Lakeland Community College are cheating, plagiarism, fabrication of material included in academic work, denying others access to information or material, enabling academic misconduct, and deception in order to gain academic advantage. Policies dealing with violations of academic misconduct may be obtained by visiting <http://www.lakelandcc.edu/web/about/student-development> or from the Student Development Office.

#### GRADING:

The final grade for this three-credit hour course will be calculated based on scores achieved on attendance, homework, quizzes, a midterm exam and a final exam. The instructor has the option of grading on a curve if the average grade is less than 80%.

91 – 100% .....	= A
83 - 90.99% .....	= B
75 – 82.99% .....	= C
68 – 74.99%.....	= D

#### BASIS FOR GRADES:

Attendance (Missing 20% of classes = 0) ---	20%
Homework .....	10%
Laboratory Assignments-----	15%

67.99 or below .....	= F	Quizzes .....	10%
Failure, non-attendance .....	= FNA	Midterm .....	20%
		Final Exam .....	25%
			Total --- 100%

**ATTENDANCE (20% of final grade):**

Attendance is a very important part of this course since the Instructor will at times be presenting and explaining information in the lecture sessions that will not be in the text book but may be included in quizzes and exams. Furthermore, employers expect employees to show up on time for every scheduled work day and this attendance requirement is intended to help students develop this ability.

**ON THE FIRST DAY OF CLASS:** You should make arrangements with two or more classmates so if you are late or have to be absent you can get any missed assignments from them. As you are expected to attend every class it is not the instructor’s responsibility or obligation to re-teach material to students who are absent.

**IF YOU ARE LATE OR ABSENT:** A student can be late for class one time; thereafter, arriving late will count as being absent for half a class. This course consists of 16 classes, so each class missed will reduce student’s final course score by 6.25% and missing three classes will result in 20% of students final course score being zero.

**LABORATORY WORK/HOMEWORK: (25% of final grade):**

Students will frequently be given laboratory work or homework assignments, such as answering end-of-chapter questions or completing an alternate assignment handed out in class, such as measuring lines or distances, creating a 3-view drawing, putting weld symbols on a drawing, etc. Homework turned in late will only get half credit. Students will, however, be given an opportunity to make up lost points by (a) participating in voluntary plant tours or (b) researching the facility offering the tour and then writing a cover letter with a resume applying for employment at that facility and submitting it to the class Instructor or (c) attending an American Welding Society meeting or event.

**QUIZZES: (10% of final grade):**

Quizzes will not necessarily be announced in advance; therefore, it is important for students to arrive on time for every class. Students who arrive late to class will not be given additional time to complete a quiz. In this course the lowest quiz score will be dropped when the student’s course grade is being calculated. Students will not be allowed to make up a missed quiz. The Instructor has the discretion to include pop-quizzes as part of their teaching method and students should be prepared for this to be done in this course.

**EXAMS: (Midterm – 25% of final grade; Final – 25%):**

Exams will commence and terminate at the pre-announced time. It is the student’s responsibility to arrive on time and complete the exam within the stated time. No additional time will be given. If a student is ill on the scheduled Midterm or Final Exam dates, he/she must phone the Instructor at least one hour before the exam is to begin. If you reach voice mail or an answering machine leave a message, clearly stating and spelling your first and last names and provide your telephone number including area code. In this message, state when you plan to take the missed exam in the Lakeland Learning Center testing room (A-1040). **NOTE: The exam must be taken within 48 hours of its scheduled administration time to avoid penalty unless an alternate time is arranged with the Instructor before the 48 hour deadline has passed.** Students must provide a picture ID for the Testing Center monitor. The student is responsible for determining Testing Center hours.

**COURSE POLICY:**

The policies and procedures for this course shall be consistent with the college policies and procedures explained in the current Student Handbook and Calendar.

**Cell phones** are to be turned off or silenced in class and lab, and photographing or video recording of class sessions and/or materials presented is not allowed without the Instructor’s permission. Cell phones cannot be used during quizzes or exams, and the Instructor reserves the right to collect and hold them while quizzes or tests are being taken. Non-compliance with this policy may result in a student being expelled from class.

**Adds, drops, and withdrawals** are per standard policies of Lakeland Community College. A student’s failure to attend the class does not constitute a withdrawal and will ultimately lead to a failing grade. Those who wish to withdraw from class should contact the Counseling Center to initiate the withdrawal procedure.

**For cancellations due to bad weather**, call the Lakeland Emergency Closing Hotline at (440) 525-7242, or check Lakeland’s web page, local radio or TV stations.

**Methods of Presentation:**

- Text book reading assignments
- Lecture
- Audio/Visual Media
- Demonstration
- On-line presentation
- Individualized instruction

**The policies, requirements and other information contained in this syllabus are subject to change at the discretion of the Instructor**

**LAKELAND COMMUNITY COLLEGE’S MISSION STATEMENT:**

**“To provide quality learning opportunities to meet the social and economic needs of the community.”**

Lakeland Community College Learning Outcomes

- Learns Actively
- Thinks Critically
- Communicates Clearly
- Uses Information Effectively
- Interacts in Diverse Environment

Essential skills for personal and professional growth

**COURSE SCHEDULE:**

Class #	Date:	Topic:	Preparation/Comments:
1			
2			
3			
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15			

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The course and services are available without regard to a participant's race, color, religion, ancestry, age, handicap, sex, marital status or national origin. The number for TDD/TYY or relay services is 440-525-7006.

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