Course Acronym:	WELD
Course Number:	20A
Descriptive Title:	Flux Cored Arc Welding (FCAW)
Division:	Industry and Technology
Department:	Welding
Course Disciplines:	Welding
Catalog Description:	This course is designed to develop Flux Cored Arc Welding (FCAW) skills and focuses on preparing students to pass the American Welding Society (AWS) D1.1 flux cored arc welding qualification and earn the semi-automatic endorsement for the Los Angeles Department of Building and Safety (LADBS) structural welding license. The course offers an in-depth study into work procedure specifications, operation and maintenance of constant voltage welding machines, occupational safety, D1.1 code, constant voltage welding theory, wire classification, metallurgy and weld inspection. Emphasis is placed on the theory and practice of joint preparation and Complete Joint Penetration (CJP) in the vertical and overhead welding positions utilizing flux cored arc welding process. Note: Letter grade or pass/no pass option.
Prerequisite:	Welding 10C or Welding 23 with a minimum grade of C
Co-requisite:	
Recommended Preparation:	
Enrollment Limitation:	
Hours Lecture (per week):	2.5
Hours Laboratory (per week):	5
Outside Study Hours:	5
Total Course Hours:	135
Course Units:	4
Grading Method:	Letter Grade and Pass/No Pass
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	fall 2018
Transfer UC:	Yes
Effective Date:	
General Education: ECC	

Term:	
Other:	
CSU GE:	
Term:	
Other:	
IGETC:	
Term:	
Other:	
Student Learning Outcomes:	**SLO #1 Safe Operations** Demonstrate safe operation of constant voltage welding machines. **SLO #2 External Repairs** Perform minor external repairs on FCAW equipment and accessories. **SLO # 3 Assigned Weldments** Perform assigned weldments using the FCAW-S process.
Course Objectives:	1. Demonstrate proper safety procedures. 2. Determine which semi-automatic welding process is optimal for use on different thicknesses of metal. 3. Determine which semi-automatic welding process is optimal for use on different joint configurations. 4. Correctly set-up and operate a constant voltage semi-automatic welding machine. 5. Identification and proper care for the various components of a wire fed welding machine and torch head accessories. 6. Correctly bevel and fit up welding joints in compliance with AWS standards. 7. Comprehend the correct practical use of various semi-automatic filler wires such as E71T-8 (NR 232), E71T-11 (NR 211) and E71T-9M-J (Outer Shield 71M). 8. Identify the metallurgy of the wires and the chemistry of the shielding gas and/or flux component.
Major Topics:	**I. WELDING INDUSTRY SAFETY (1.25 hours, lecture)** A. Industry safety standards B. Review safety procedures and equipment C. Laboratory and tool room protocol **II. CONSTANT VOLTAGE SEMI-AUTOMATIC WELDING EQUIPMENT (5 hours, lab)** A. Perform safety inspection of semi-automatic welding equipment and accessories B. Set-up for Flux Cored Arc Welding - Self-shielded operating parameters C. Surfacing welds- flat position **III. SEMI-AUTOMATIC WELDING OPERATION AND SAFETY (5 hours, lecture)** A. Safety precautions B. Characteristics of the FCAW and Gas Metal Arc Welding (GMAW) C. Constant voltage power supply

D. Wire feeder and welding gun selection

IV. PERFORMING MULTI-PASS FILLET WELDS USING FCAW-S (15 hours, lab)

A. 2F position
B. 3F position

V. FCAW-G and GMAW SHIELDING GAS (1.25 hours, lecture)

A. Shielding gas composition
B. Shielding gas options

VI. V-GROOVE BUTT JOINT CONFIGURATION (5 hours, lab)

A. Using an oxyacetylene cutting torch, band saw or grinder to create 22.5 degree bevels
B. 3G V-groove preparation and fit up

VII. FCAW PROCEDURES AND TECHNIQUES (10 hours, lecture)

A. Exploring Welding Procedure Specifications (WPS) and how they are used in the industry
B. Troubleshooting common FCAW problems
C. Proper technique

VIII. PROPER APPLICATION OF ROOT AND FILL PASSES IN V-GROOVE USING FCAW-S (15 hours, lab)

A. Torch angle parameters
B. Effects of improper torch angle
C. Contact Tip to Work Distance (CTWD)

IX. FCAW INSPECTION, DEFECTS AND CORRECTIVE ACTIONS (8.5 hours, lecture)

A. Understanding the difference between a defect and a discontinuity
B. Weld and base metal discontinuities
C. Nondestructive testing

X. FCAW-S OPEN ROOT WELDING (20 hours, lab)

A. Proper root opening and joint preparation
B. Complete Joint Penetration (CJP)
C. Back gouging and back welds
D. 2G and 3G positions

XI. APPLICATION OF FCAW AND GMAW PROCESSES IN INDUSTRY (10 hours, lecture)

A. FCAW structural steel field welding
B. GMAW uses in light fabrication and the auto industry
C. FCAW-G application in fabrication shops and pipe welding
D. Employment opportunities

	XII. DESIGN CONSIDERATIONS OF WELDMENTS (9 hours, lecture) A. Filler metal characteristics B. Arc characteristics C. Electrical theory and magnetism D. Effects of welding variable changes **XIII. FCAW - SELF SHILEDED (FCAW-S) (30 hours, lab)** A. Vertical V-groove (3G) B. Overhead V-groove (4G)
Total Lecture Hours:	45
Total Laboratory Hours:	90
Total Hours:	135
Primary Method of Evaluation:	3) Skills demonstration
Typical Assignment Using Primary Method of Evaluation:	Perform welding exercises that simulate structural welding using FCAW-S. Test plates shall be welded in the 3G and 4G positions in accordance with D1.1 test plate criteria for qualification. When completed, submit test plates to the instructor for evaluation. The plates will be examined for any discontinuities or defects, and then visually inspected per AWS D1.1 visual acceptance criteria for performance qualification.
Critical Thinking Assignment 1:	Perform a welding operation from a written welding procedure specification. Adjust the settings to those within acceptable ranges of what the WPS calls for. After the instructor checks for compliance, perform the welding operation per the welding procedure specification. When complete, the weldment and WPS will be submitted to the instructor to evaluate per AWS acceptance criteria.
Critical Thinking Assignment 2:	Provided with a constant voltage machine that is not working correctly, navigate the process to troubleshoot the issue per information learned during lecture. Check the power supply, drive rollers, polarity, gas shielding, contact tip, liner, wire tension, voltage and wire feed speed to determine the issue. Demonstrate the troubleshooting process and report findings to the instructor. Produce a quality weld with the machine to show mastery of the troubleshooting process and submit to the instructor.
Other Evaluation Methods:	Class Performance, Completion, Homework Problems, Matching Items, Multiple Choice, Performance Exams, Quizzes
Instructional Methods:	Demonstration, Discussion, Field trips, Guest Speakers, Lab, Lecture, Multimedia presentations
If other:	
Work Outside of Class:	Answer questions, Problem solving activity, Required reading, Study
If Other:	
Up-To-Date Representative Textbooks:	Andrew Daniel Althouse, Carl H. Turnquist, William A. Bowditch, Kevin E. Bowditch. Modern Welding. 13th edition. Goodheart-Willcox, 2024 William H. Minnick, James Mosman. GMAW/FCAW Handbook. 2nd edition. Goodheart-Willcox, 2023
Alternative Textbooks:	

Required Supplementary Readings:	Welding Guides, Lincoln Global Incorporated, 2018. (Discipline Standard)
Other Required Materials:	Welding helmet Welding gloves Protective footwear Safety glasses Chipping hammer Wire brush
Requisite:	Prerequisite
Category:	sequential
Requisite course(s): List both prerequisites and corequisites in this box.	Welding-10C Welding-23
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	**Ability to pass SMAW 3G and 4G qualification tests. Strong understanding of general welding theory and principles.** WELD 23 - Utilize safety procedures for safe operation of tools, machines and welding equipment found in a welding facility. WELD 10C - Set up and use various welding and cutting apparatus. WELD 10C - Prepare a metal test plate for welding. WELD 23 - Select the proper current, current setting, and manipulation techniques for any given electrode. WELD 10C - Correctly set up and use a constant current welding machine SMAW or constant voltage welding machine FCAW. WELD 10C - Operate welding equipment properly and safely. WELD 10C - Identify proper electrodes for material and joint fit up. WELD 10C - Demonstrate the proper measures to overcome "arc blow". WELD 23 - Pass the coupon bend stress test used for passing the practical Angeles Structural welding certification/ AWS D1.1 welding certification examinations.
Requisite Skill:	
Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable	
Requisite course:	
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Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Renee Newell
Date:	03/22/2016
Original Board Approval Date:	06/19/2017
Last Reviewed and/or Revised by:	Dylan Meek
Date:	04/25/2022
Last Board Approval Date:	06/17/2024 effective FA 2025