



El Camino College
COURSE OUTLINE OF RECORD – Official

Course Acronym:	WELD
Course Number:	1A
Descriptive Title:	Introduction to Multi-Process Welding
Division:	Industry and Technology
Department:	Welding
Course Disciplines:	Welding
Catalog Description:	<p>This course is designed to provide students with basic performance qualification skills needed for employment in manufacturing and the maintenance industry. Students are introduced to multiple processes with a primary focus on developing manipulative skills commonly used in manufacturing. Welding processes covered include oxy-acetylene cutting, plasma arc cutting, Shielded Metal Arc Welding (SMAW), Gas Tungsten Arc Welding (GTAW), and Gas Metal Arc Welding (GMAW). The course also includes a study of occupational safety, weld symbols, and joint design.</p> <p>Note: Letter grade or pass/no pass option.</p>
Prerequisite:	
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:	No
Effective Date:	
General Education:	ECC
Term:	
Other:	

CSU GE:	
Term:	
Other:	
IGETC:	
Term:	
Other:	
Student Learning Outcomes:	<p>SLO #1 Safe Set-Up</p> <p>Students will be able to demonstrate the safe set up and operation of welding equipment using all applicable personal protective equipment.</p> <p>SLO #2 Specification Designators</p> <p>Students will be able to identify the different specification designators related to various process electrodes.</p> <p>SLO #3 Flux Coating Versus Gas Shielding</p> <p>Students will be able to describe the differences of a flux coating versus gas shielding.</p>
Course Objectives:	<ol style="list-style-type: none"> 1. Safely operate various welding equipment for SMAW, GMAW, and GTAW. 2. Associate the five essentials of welder controls to discontinuities created in weldment. 3. Identify the abbreviated symbols used in industry for electrode specifications. 4. Identify the effects of too much heat input on weldment. 5. Recognize the five common joints used in welding.
Major Topics:	<p>I. OVERVIEW OF WELDING FOR MANUFACTURING AND MAINTENANCE (3 hours, lecture)</p> <ol style="list-style-type: none"> A. Safety procedures B. Overview of laboratory protocol C. Welding processes used in manufacturing and maintenance <p>II. OVERVIEW OF EQUIPMENT (4.5 hours, lab)</p> <ol style="list-style-type: none"> A. Safe set-up of weld equipment B. SMAW inverter C. Demonstration of how to change from DC- to DC+ with analog connections <p>III. CUTTING TECHNIQUES AND KERF (3 hours, lecture)</p> <ol style="list-style-type: none"> A. Iron worker shear B. Plasma cutting C. Band saws D. Oxyacetylene cutting torch E. Flame characteristics and applications <ol style="list-style-type: none"> 1. Carburizing 2. Neutral 3. Oxidizing flame

- F. Torch angle and manipulation

IV. CUTTING TECHNIQUES - THERMAL AND MECHANICAL (5 hours, lab)

- A. Plasma
- B. Shear
- C. Band saw
- D. Oxyacetylene cutting torch

V. ESSENTIAL PARAMETERS THE WELDER CONTROLS (3 hours, lecture)

- A. Polarity choices
- B. Travel and work angle of electrode
- C. Diameter and flux covering of electrode
- D. Arc length or Contact to Work Distance (CTW)
- E. Travel Speed

VI. SMAW WELDING BASICS (2.5 hours, lab)

- A. Surface beading in the flat position
- B. Striking an arc

VII. FABRICATION OF METAL CROSS (7.5 hours, lab)

- A. Tacking
- B. Puddle identification
- C. Running beads with electrodes
- D. Manipulation of the electrode

VIII. SMAW ELECTRODE SPECIFICATION IDENTIFICATION (2.5 hours, lecture)

- A. Tensile strength
- B. Position
- C. Characteristics of flux

IX. HORIZONTAL FILLET WELD (2F) POSITION OF METAL CROSS (10 hours, lab)

- A. Understanding the work angle
- B. Performing multi-passes
- C. Equal legs and flush face

X. SMAW MANIPULATION TECHNIQUE (2.5 hours, lecture)

- A. Importance of fusion
- B. Difference between drag rod and whip rod
- C. Control of weld puddle size
- D. Arc force control

XI. CONTROL OF ELECTRODE ANGLE (15 hours, lab)

- A. Vertical fillet weld (3F) position on metal cross
- B. The effects of gravity on the puddle

- C. Keeping puddle size to code
- D. Exploring how positioning of weldment effects electrode choice
- E. Flush cover

XII. GMAW (5 hours, lecture)

- A. Set up of constant voltage machine
- B. Shielding gas options for solid wire welding
- C. Contact to Work Distance (CTWD)
- D. Amperage/wire feed
- E. Torch travel angle and positioning

XIII. GMAW (12.5 hours, lab)

- A. Set-up machine and wire feeder correctly
- B. Using correct travel angle
- C. Proper CTWD
- D. Tacking up thin gauge metal cross
- E. Tying beads together with proper heat and travel speed

XIV. THE EFFECTS OF HEAT INPUT IN WELDMENT (9 hours, lecture)

- A. Choices of weld processes
- B. Filler metal considerations
- C. Joint design considerations
- D. Grain structure changes due to heat

XV. WELDING CROSSES (5 hours, lab)

- A. GMAW
- B. SMAW

XVI. PORTABILITY OF PROCESSES (2.5 hours, lecture)

- A. Code limitations
- B. Environmental effects
- C. Requirements for weld machine accessories

XVII. WELDABILITY OF METALS AND ELEMENTS (5 hours, lecture)

- A. Ferrous vs nonferrous metals
- B. Thin gauge vs structural
- C. Choosing filler metal to match base metal

XVIII. GTAW (3 hours, lecture)

- A. Set up of equipment and weld torch head
- B. Polarity settings
- C. Importance of shielding gas
- D. High frequency arc
- E. Tungsten shape and grind techniques

	<p>XIX. GTAW 1G POSITIONING (7.5 hours, lab)</p> <ul style="list-style-type: none"> A. Using carbon steel, practice push angle and filler metal feed technique B. Tacking weld pieces together, aiming for full penetration C. Consistency on bead size <p>XX. GTAW PUDDLE CONTROL (5 hours, lecture)</p> <ul style="list-style-type: none"> A. The effects of torch push angle B. Parameters of work angles C. Tungsten electrode arc length D. Tungsten shape <p>XXI. GTAW ALUMINUM WELDING (15 hours, lab)</p> <ul style="list-style-type: none"> A. Alternating Current (AC) welding B. Weld puddle control on metal with high thermal conductivity characteristics C. Square wave technology control parameters <p>XXII. WELDING PROCESSES - REVIEW (1.5 hours, lecture)</p> <ul style="list-style-type: none"> A. Cumulative review of all processes used B. Joint fit up, metal thickness, and portability considerations for process choice C. Flux or gas shielding considerations D. Characteristics of base and filler metal E. Heats affect on metal <p>XXIII. PARAMETERS OF TORCH ANGLE ON WELD JOINTS (5.5 hours, lab)</p> <ul style="list-style-type: none"> A. Tee joint B. Lap joint C. Various positions
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:	Regarding the effects of heat input created by welding, determine whether to run a single or multi-pass weld based on the type of base metal, thickness of material and application that the instructor provides. Perform the weld and submit the results to the instructor.
Critical Thinking Assignment 1:	When welding a specific joint design or metal thickness that is provided by the instructor, determine the best process to use: SMAW versus GMAW or GTAW. Produce a weld according to their conclusions and submit the weld to the instructor for evaluation.
Critical Thinking Assignment 2:	Provided with a constant voltage machine that is not working correctly. And using the information gathered during lecture, go through a checklist to ascertain what the problem is. Inspect and check the polarity, power supply, shielding gas flow, wire feeding

	mechanism, liner and contact tip to determine where the issue is occurring. Navigate through the process with the instructor and present your findings.
Other Evaluation Methods:	Class Performance, 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:	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. <u>Modern Welding</u> . 13th edition. Goodheart-Willcox, 2024
Alternative Textbooks:	
Required Supplementary Readings:	American Welding Society (AWS) Welding Journal
Other Required Materials:	Safety glasses Welding helmet Leather gloves Wire brushes Chipping hammer
Requisite:	
Category:	
Requisite course(s): List both prerequisites and corequisites in this box.	
Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).	
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Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Renee Newell
Date:	10/02/2015
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