# El Camino College

**COURSE OUTLINE OF RECORD - Approved**

## I. GENERAL COURSE INFORMATION

**Subject and Number:** Welding 10B
**Descriptive Title:** Intermediate Shielded Metal Arc Welding (SMAW)

**Course Disciplines:** Welding

**Division:** Industry and Technology

**Catalog Description:** This course is designed for the intermediate student. Students will develop manipulative skills using the semi-automatic and Shielded Metal Arc Welding (SMAW) processes. The course emphasizes the theory and practice of V-groove joint preparation, vertical (3G) and overhead (4G) welding, thermal cutting, and blueprint reading based on the American Welding Society (AWS) standards in weld symbols and ferrous alloys. Innershield wire (NR232) and duel shield wire will be explored in Flux Core Arc Welding (FCAW).

**Conditions of Enrollment:** **Recommended Preparation**
Welding 10A

**Course Length:** [X] Full Term [ ] Other (Specify number of weeks):
**Hours Lecture:** 2.50 hours per week [ ] TBA
**Hours Laboratory:** 5.00 hours per week [ ] TBA
**Course Units:** 4.00

**Grading Method:** Both
**Credit Status** Associate Degree Credit

**Transfer CSU:** [X] Effective Date: 2/18/2014
**Transfer UC:** [ ] No

**General Education:**
**El Camino College:** _____
**CSU GE:** _____
**IGETC:** _____

## II. OUTCOMES AND OBJECTIVES

### A. COURSE STUDENT LEARNING OUTCOMES (The course student learning outcomes are listed below, along with a representative assessment method for each. Student learning outcomes are not subject to review, revision or approval by the College Curriculum Committee)

1. Welding students will produce quality welds utilizing various welding techniques.
2. Students will understand Blueprint symbols and their relationship to the weldment.
3. Student will exhibit knowledge in electrode identification, weldability of metals, joint design and power sources.

The above SLOs were the most recent available SLOs at the time of course review. For the most current SLO statements, visit the El Camino College SLO webpage at http://www.elcamino.edu/academics/slo/.

### B. Course Student Learning Objectives (The major learning objective for students enrolled in this course are listed below, along with a representative assessment method for each)

1. Demonstrate proper welding safety procedures.
   Class Performance
2. Select between various welding processes to complete a joint.
   Performance exams
3. Cut various metals utilizing oxygen-fuel, carbon arc and plasma arc processes.
   Performance exams
4. Differentiate between a F3 and F4 category weld electrode.
   Multiple Choice
5. Correctly set up and use a constant current SMAW and Gas Tungsten Arc welding (GTAW) machine.
   Performance exams
6. Correctly set up and use a constant voltage Gas Metal Arc Welding (GMAW) and FCAW machine.
   Performance exams
7. Prepare metal joints for welding.
   Performance exams
8. Use various welding processes in joining metals.
   Performance exams
9. Comprehend blueprint reading.
   Multiple Choice
10. Interpret welding symbols and acronyms according to AWS A2.4.
    Multiple Choice

**III. OUTLINE OF SUBJECT MATTER (Topics are detailed enough to enable a qualified instructor to determine the major areas that should be covered as well as ensure consistency from instructor to instructor and semester to semester.)**

| Lecture or Lab | Approximate Hours | Topic Number | Major Topic |
|---|---|---|---|
| Lecture | 2 | I | ORIENTATION<br><br>A. Reviewing safety procedures<br>B. Safety exam<br>C. Syllabus and course objectives |
| Lab | 4 | II | ORIENTATION - LAB<br><br>A. Reviewing equipment set up<br>B. Tool room criteria<br>C. Safety in the lab<br>D. Running E7018 electrodes |
| Lecture | 5 | III | WELDING METALLURGY FUNDAMENTALS - REVIEW<br><br>A. Size of electrode<br>B. Heat generated by puddle size and it's effect on HAZ<br>C. Cutting techniques<br>D. Heat input and tip size related to base metal thickness |
| Lab | 10 | IV | TRACK CUTTERS AND MECHANICAL CUTTING EQUIPMENT<br>A. Cutting and preparing V-groove<br>B. 45 degree included angle<br>3G OR 2G POSITION IN 1/8" E 7018<br>A. Joint fit up<br>B. Using backing strip |
| Lecture | 5 | V | PHYSICAL LAWS OF GRAVITY<br>A. Excessive voltage on the control of electric arc welding<br>B. Long arcing or too extreme of push angle<br>C. Out of position welds<br>D. Controlling the puddle<br>BLUEPRINT ESSENTIALS<br>A. Symbols<br>B. Acronyms |

| | | | |
|---|---|---|---|
| Lab | 10 | VI | 3G POSITION<br>A. Rod angle<br>B. Arc length<br>C. Amperage<br>D. Travel speed<br>E. Starting in 3G position |
| Lecture | 8 | VII | FIVE WELD JOINT TYPES - REVIEW<br>A. Designing and fabricating weldments<br>B. Structural configuations<br>C. Groove or fillet weld<br>BLUEPRINT READING EXERCISES<br>A. Design and fabrication of weldments<br>B. Joint and weld type |
| Lab | 10 | VIII | STRINGER COVER<br>A. Destructive testing to evaluate root pass<br>B. Washer bead technique to clean up middle passes |
| Lecture | 3 | IX | NON DESTRUCTIVE TESTING TECHNIQUES<br>A. Visual<br>B. Dye penetrant<br>C. Magnetic particle<br>D. Other certifications<br>1. Level I NDT<br>2. Level III NDT |
| Lab | 10 | X | FOLLOWING BLUEPRINT INSTRUCTIONS<br>A. Fabrication of coping corner joint<br>B. Visual inspection (VT) for dimension requirement<br>C. Performing Non Destructive Testing (NDT) with Dye penetrate (PT) and developer |
| Lecture | 5 | XI | D1.1 CODE<br>A. D1.1 Code Book - Clause 2<br>B. Importance of a fillet weld<br>C. Rule of fillet welds and lap joints<br>AWS 12.4 CODE BOOK SYMBOLS |
| Lab | 6 | XII | LAP JOINTS in 2F AND 3F POSITIONS<br>A. 2" x 5" x 3/8" coupons<br>B. Visual inspection using fillet weld gauge to test leg size |

| | | | |
|---|---|---|---|
| | | | C. Maintaining consistant bead size<br>D. Working on bead control |
| Lecture | 3 | XIII | FLUX CORE ARC WELDING (FCAW)<br>A. Introduction to FCAW theory<br>B. FCAW technique<br>C. Differences between NR232 and duel shield<br>D. Contact to Work (CTW) distance and wire feed angle<br>E. Dual shield inert shielding gases and mixtures<br>F. Troubleshooting FCAW equipment and welds |
| Lab | 14 | XIV | FCAW TECHNIQUES<br>A. Design and application considerations<br>B. Application of principles in FCAW processes and equipment<br>C. Review GMAW |
| Lecture | 5 | XV | OUT OF POSITION WELDING<br>A. Overhead is same puddle and drag angle as flat<br>B. Mind over matter - visualize what the puddle should look like<br>PUDDLE PROFILE AND STRUCTURAL FORMATION<br>A. Side drag technique or pulling rod towards oneself<br>B. No push angle or welding in the forward direction |
| Lab | 14 | XVI | OVERHEAD / 4G POSITION IN E7018 ROD<br>A. Control of rootpass and stringer beads<br>B. Control of cover pass<br>C. VT of cover pass<br>D. Destructive testing<br>1. Test strips<br>2. Bend coupons |
| Lecture | 4 | XVII | Overview of Gas Tungsten Arc Welding (GTAW)<br>A. Equipment review<br>B. Welding Parameters<br>C. Torch angle |
| Lab | 12 | XVIII | GTAW Techniques<br>A. Design and application considerations<br>B. Application of principles in GTAW processes and equipment |

| | | | |
|---|---|---|---|
| Lecture | 5 | XIX | WELDING TECHNIQUES - REVIEW<br>A. Filler metal characteristics<br>B. 3G and 4G performance requirements<br>C. Weld joint types and welding symbols<br>D. Design considerations of weldments<br>E. Arc welding processes and equipment<br>F. Arc electrical current characteristics<br>G. Effects of welding variable changes<br>EMPLOYMENT OPPORTUNITIES<br>A. Technical job websites<br>B. Online resumes |
| **Total Lecture Hours** | | 45 | |
| **Total Laboratory Hours** | | 90 | |
| **Total Hours** | | 135 | |

## IV. PRIMARY METHOD OF EVALUATION AND SAMPLE ASSIGNMENTS

### A. PRIMARY METHOD OF EVALUATION:

Skills demonstrations

### B. TYPICAL ASSIGNMENT USING PRIMARY METHOD OF EVALUATION:

Perform a 3G weldment on 1" plate with a cover pass that rates within the D1.1 visual inspection; exhibits no undercut, has 1/8" or less buildup on face, and no underfill overlap.

### C. COLLEGE-LEVEL CRITICAL THINKING ASSIGNMENTS:

1. Analyze a weld puddle and provide an overview of techniques that can be used to control the effects of variable changes. Write on a lab report the effects of: long arcing, increasing or decreasing electrode drag or push angle, short arcing to control arc blow, travel speed consistancy to accomodate heat, and polarity.
2. Assemble two joint fit ups, one with a back up strip, the other with an open root. Each will be welded with an E6010 rod. Analyze each set up, assessing to assure the root joint has a landing strip on the root face and the joint with the backing strip fit up is constructed with a beveled groove, not champfered.

### D. OTHER TYPICAL ASSESSMENT AND EVALUATION METHODS:

Performance exams

Quizzes

Class Performance

Homework Problems

Multiple Choice

Completion

Matching Items

## V. INSTRUCTIONAL METHODS

Demonstration
Discussion
Field trips
Guest Speakers
Internet Presentation/Resources
Laboratory
Lecture
Multimedia presentations

**Note: In compliance with Board Policies 1600 and 3410, Title 5 California Code of Regulations, the Rehabilitation Act of 1973, and Sections 504 and 508 of the Americans with Disabilities Act, instruction delivery shall provide access, full inclusion, and effective communication for students with disabilities.**

## VI. WORK OUTSIDE OF CLASS

Study
Answer questions
Problem solving activities

**Estimated Independent Study Hours per Week:** 4.5

## VII. TEXTS AND MATERIALS

A. **UP-TO-DATE REPRESENTATIVE TEXTBOOKS**
1. Andrew Daniel Althouse, Carl H. Turnquist, William A. Bowditch, Kevin E. Bowditch . Modern Welding. 11th ed. Goodheart-Willcox, 2012.
Qualifier Text: Modern Welding is a comprehensive text that has long been the standard for teaching the theory, fundamentals, equipment, and techniques of welding technology. This text provides thorough coverage of common welding and cutting processes, including gas tungsten arc welding, gas metal arc welding, shielded metal arc welding, oxyfuel gas cutting, plasma arc cutting, and resistance welding. The text also includes extensive instruction in welding symbol interpretation, weld testing and inspection, and employment in the welding field.,

B. **ALTERNATIVE TEXTBOOKS**

C. **REQUIRED SUPPLEMENTARY READINGS**
Handouts from the AWS Structural Steel Codebook D1.1
Weld Symbols A2.4
Lap Joint
Power Point handouts

D. **OTHER REQUIRED MATERIALS**
Safety equipment and personal protective gear

## VIII. CONDITIONS OF ENROLLMENT

### A. Requisites (Course and Non-Course Prerequisites and Corequisites)

| Requisites | Category and Justification |
|---|---|

### B. Requisite Skills

| Requisite Skills |
|---|

### C. Recommended Preparations (Course and Non-Course)

| Recommended Preparation | Category and Justification |
|---|---|
| Course Recommended Preparation<br>Welding-10A | |

### D. Recommended Skills

| Recommended Skills |
|---|
| Ability to operate SMAW equipment. WELD 10A -<br>Properly set up regulators, safely light and adjust oxy-acetylene flame to a neutral flame.<br>WELD 10A -<br>Weld in a flat, horizontal, vertical, or overhead position.<br>WELD 10A -<br>Safely operate SMAW equipment.<br>WELD 10A -<br>Evaluate the numbering system of the SMAW electrode.<br>WELD 10A -<br>Identify the five essentials of welding.<br>WELD 10A -<br>Explain how the application of heat affects a weldment.<br>WELD 10A -<br>Identify different weld joints. |

### E. Enrollment Limitations

| Enrollment Limitations and Category | Enrollment Limitations Impact |
|---|---|

**Course created by Renee Newell on 11/01/2013.**

**BOARD APPROVAL DATE: 02/18/2014**

**Last Reviewed and/or Revised by Renee Newell on 11/01/2013**

18373