

FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT

WELD 140A/B

Mathematics for Welding Technicians

Date: April 2016

Proposed Grade Level: 10-12

Grading: A-F

**Pre-Requisites: Recommended enrollment
in CTE metals pathway**

CTE Sector/Pathway: N/A

Course Length: Two Semesters

Subject Area: Mathematics

Credits: Semester 1-General Math (5)

Semester 2-IM 2 Foundations A (5)

Articulation Units: N/A

Specialized Program: N/A

Intent to Pursue College Prep Status through the UC System: NO

COURSE DESCRIPTION:

This is an integrated course that provides practical mathematics as it applies to technical and trade professions. The first semester of this course builds a strong foundation of the concrete concepts of arithmetic to the abstract thinking of algebra. Students will apply and extend those skills in the second semester of this course, bridging procedural fluency, conceptual understanding, and modeling of mathematics. Some of the key mathematical concepts of this course include whole number and decimal operations, simple and complex fractions, percentage, ratios and proportions, algebra, rational and irrational numbers, geometry, and trigonometry, and calculator applications. Students build competence in a broad range of mathematical problem-solving skills. This course takes a project-based learning approach to developing students' mathematical understanding through hands-on activities. Students use mathematical formulas and geometric concepts to design and fabricate scale models of projects to be completed in the metals class. This course is part of a building and trades curriculum that aligns with the American River College WELD 140 course.

This course is a requirement for the American River College certificate and degree program for welding. The purpose of WELD 140 is to train welding technicians to do problem solving in the work place.

GENERAL GOALS/ESSENTIAL QUESTIONS:

As stated in the California Mathematics Framework, the conceptual category of modeling at the higher mathematics level goes beyond the simple application of previously constructed mathematics and includes real-world problems. True modeling begins with students asking a question about the world around them, and the mathematics is then constructed in the process of attempting to answer the question. Modeling problems have an element of being genuine problems, in the sense that students care about answering the question under consideration. Mathematical modeling is a major theme of this course as it is aimed at practical mathematics as applied to technical and trade workers. Mathematical principles are used to solve real world and work problems. Upon completion of the course the student will be able to:

- Interpret and apply common welding formulas
- Demonstrate problem-solving skills for technical trade work
- Analyze problems that are encountered in metal fabrication
- Solve equations needed in the welding field

- Pose mathematical questions

Upon completion of this course are the students prepared to synthesize, interpret and apply mathematics to the common conditions set forth in employment as a metal fabricator/welder.

CCSS READING/WRITING/LISTENING COMPONENT:

- Students will analyze the content of their textbook as well as the process to decode and understand technical drawings for the purposes of fabrication.
- Apply word problems within the context of specific mathematical applications related to metal fabrication, workplace and project budgeting of labor and materials
- Students will be expected to communicate the ideas and interpretations of drawings as well as creating their own drawings in writing.
- Use specific symbols and unique language to the craft of metal fabrication in describing their projects and proposals.
- Students will be expected to communicate orally to problem solve and instruct the teacher and class on the progress of their current, past or future projects.
- Articulate their project plans to fellow classmates and be involved with question and answer sessions to vet any possible mistakes.
- Students will utilize the Eight Standards for Mathematical Practice.

CTE INDUSTRY SECTOR/PATHWAY/STANDARDS:

C1.2: Interpret scaled welding blueprints; gather design and materials information; perform calculations; and use the detail to plan, lay out, and produce parts or finished products

C9.2: Understand that a welding production management system includes planning, engineering, organizing, and controlling resources and manufacturing processes

DETAILED UNITS OF INSTRUCTION:

Units	Learning Goals
Chapter 1 (optional) Whole Numbers	<ul style="list-style-type: none"> • Addition of whole numbers • Calculator addition • Subtraction of whole numbers • Calculator subtraction • Multiplication of whole numbers • Calculator multiplication • Division of whole numbers • Calculator division
Chapter 2 Common Fractions	<ul style="list-style-type: none"> • Changing whole or mixed numbers to improper fractions • Changing improper fractions to whole or mixed numbers • Changing a fraction to lowest terms • Changing a fraction with a given denominator • Changing two or more fractions to equivalent fractions • Addition of fractions

	<ul style="list-style-type: none"> • Addition of mixed numbers • Subtraction of fractions • Subtraction of mixed numbers multiplication of fractions • Division of fractions • Problems involving multiplication and division • Complex fractions
Chapter 3 Decimal Fractions	<ul style="list-style-type: none"> • Changing a decimal fraction to a common fraction • Changing a common fraction to a decimal fraction • Using a table of decimal equivalents • Conversion of dimensions • Addition of decimals • Subtraction of decimals • Multiplication of decimals • Division of decimals • Using the calculator to solve decimal problems
Chapter 4 Percentage	<ul style="list-style-type: none"> • Finding percentage given base rate • Finding the rate given base and percentage • Finding the base given percentage and rate • Using the calculator to find: percentage, base, and rate • The P-R-B Triangle
Chapter 5 Ratio and Proportion	<ul style="list-style-type: none"> • Ratio • Reduction of Ratios to lowest terms • Proportion • Using the calculator to solve proportion problems • Averages • Using the calculator to find the average of a set of numbers
Chapter 6 Practical Algebra	<ul style="list-style-type: none"> • Use of letters • Negative numbers • Definitions • Substitution • Addition • Subtraction • Symbols of grouping • Multiplication • Division • Equations
Chapter 7 Rectangles and Triangles	<ul style="list-style-type: none"> • Area of surfaces and units of area • Perimeter of a rectangle • Finding length and width of a rectangle • Squares and square roots • Square roots of whole numbers • Square roots of mixed numbers • Using the calculator to solve square root problems • Applications of square roots

	<ul style="list-style-type: none"> • Triangles • Areas of isosceles triangles • Areas of scalene triangles • Using the calculator to solve triangle problems • Angles in triangles • Using the calculator for angle measure in D.MS
Chapter 8 Regular Polygons	<ul style="list-style-type: none"> • Equilateral Triangles • Squares • Regular hexagons • Regular octagons • Using the Table of Constants • Regular polygons and calculator use • Quadrilaterals • Composite figures • Scale • Drawing measure and actual dimension • Circumference and area of circles and the converse • Ring sections and area • Arcs and sectors • Ellipse • Formulas for plane figures
Chapter 9 Solids	<ul style="list-style-type: none"> • Prisms and cylinders • Pyramids and cones • Volume and surface area • Frustum of a pyramid or cone • Volume of a ring • Volume of composite solid figures • Weights of materials • Weights of castings from patterns • Board measure • Flooring
Chapter 10 (optional) Metric Measure	<ul style="list-style-type: none"> • Units of length, area, volume and weight • Converting English to metric for length, area, volume and weight • Converting English to metric temperature
Chapter 11 (optional) Graphs	<ul style="list-style-type: none"> • Types of graphs • Combining two or more graphs • Circle and bar graphs
Chapter 12 Measuring Instruments	<ul style="list-style-type: none"> • Micrometer • Ten-thousandths micrometer • Vernier Caliper • Protractor • Vernier Protractor • Planimeter and its use
Chapter 13	<ul style="list-style-type: none"> • Applications of geometry

Geometric Constructions	<ul style="list-style-type: none"> • Constructions: bisecting a segment, angle, and arc • Constructions: perpendicular to endpoint; line through a point • Constructions: parallel lines • Constructions: congruent angles and equilateral triangles
Chapter 14 (optional) Logarithms	<ul style="list-style-type: none"> • Characteristic and Mantissa • Use of tables • Operations of logarithms • Raising a number to any power and extracting roots • Logarithms and the calculator
Chapter 15 Essentials of Trigonometry	<ul style="list-style-type: none"> • The right triangle • Trigonometric functions • Use of tables • Sin, cos, tan on the calculator • Finding angle measures • Solutions of right triangles • Isosceles triangles
Chapter 16 Strength of Materials	<ul style="list-style-type: none"> • Stress and strain • Kinds of stresses • Unit stress • Elastic limit • Ultimate strength • Safety factor • Working unit stresses • Pressure in pipes • Riveted joints
Chapter 18 Tapers	<ul style="list-style-type: none"> • Computing taper and diameter • American standard self-holding (slow) taper series • Taper angle • Taper turning by offsetting the tail stock • Taper turning by using the compound rest • Taper turning by using the taper attachment
Chapter 19 Speed Ratios of Pulleys and Gears	<ul style="list-style-type: none"> • Gear trains • Idlers • Finding the number of teeth for a given speed ratio • Compound gearing • Worm and gear • Trains of spur, bevel, and worm gearing • Pulley trains
Chapter 20 Screw Threads	<ul style="list-style-type: none"> • Pitch • Lead • Definitions applying to screw threads • Sharp V-Thread • Double depth of sharp V-Thread • Minor diameter • Tap drill sizes • The unified thread

	<ul style="list-style-type: none"> • Double depth of the unified thread • Minor diameter of unified threads • American National Thread • Double Depth of American National Thread • Size of tap drill for American National Thread • Size of tap drill for American National Threads • Width of point of tool • Square thread • Tap drill for square thread • The Acme 29-degree screw thread • Tap drill and tap, Acme thread • The Brown and Sharpe 29-degree worm thread • Metric standard screw threads • American Standard taper pipe threads • Length of part having perfect threads and length of effective thread • Thickness of metal between bottom of thread and inside of pipe in straight pipe thread • Lathe gearing for cutting screw threads • Fractional threads • Use of compound gearing • Cutting metric threads
<p>Chapter 21 Cutting Speed and Feed</p>	<ul style="list-style-type: none"> • Cutting speed and surface, or rim, speed • Cutting speed on the lathe • Cutting feed of a lathe • Drill press and milling machine • Drill press feed • Milling machine feed • Surface speed or rim speed • Finding the number of revolutions per minute, given the diameter and the cutting speed • Finding the diameter, given the rim speed and the number of revolutions per minute
<p>Chapter 22 Gears</p>	<ul style="list-style-type: none"> • Spur gears • Diametral pitch • Proportions of gear teeth • Relation between circular pitch and diametral pitch • Clearance • Depth of tooth • Outside diameter • Pitch diameter • Use of formulas • Racks • Center-to-center distance of gears • Selection of cutters • Bevel gears • Definitions applying to bevel gears-pitch cones

- | | |
|--|---|
| | <ul style="list-style-type: none"> • Tooth parts • Pitch cone radius • Addendum angle and turning angle • Dedendum angle and cutting angle • Outside diameters • Selecting cutters for bevel gears • Dimensions of teeth at small end • Miter gears |
|--|---|

TEXTBOOK AND RESOURCE MATERIALS:

SUGGESTED TEXT: *Mathematics for Technical and Vocational Students*, Tenth Edition. Boyce, Margolis & Slade, Prentice Hall.

SUBJECT AREA STANDARDS TO BE ADDRESSED:

The content standards to be addressed in this course are:

The Number System

Apply and extend previous understandings of multiplication and division to divide fractions by fractions.

- 6.NS 1: Interpret and compute quotients of fractions and solve word problems involving division of fractions by fractions.

Compute fluently with multi-digit numbers and find common factors and multiples.

- 6.NS 2: Fluently divide multi-digit numbers using the standard algorithm.
- 6.NS 3: Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.
- 6.NS 4: Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1 – 100 with a common factor as a multiple of a sum of two whole numbers with no common factor.

Apply and extend pervious understanding of operations with fractions to add, subtract, multiply, and divide rational numbers.

- 7.NS 1: Apply and extend pervious understandings of addition, subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line.
- 7.NS 2: Apply and extend previous understanding of multiplication and division and of fractions to multiply and divide rational numbers.
- 8.NS 1: Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expression repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.

- 8.NS 2: Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions.

Ratios and Proportional Reasoning

Analyze proportional relationships and use them to solve real world and mathematical problems.

- 7.RP 1: Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.
- 7.RP 2b: Identify the constant of proportionality in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
- 7. RP 2c: Represent proportional relationships by equations.
- 7.RP 3: Use proportional relationships to solve multi-step ratio and percent problems.

Expressions and Equations

Analyze and solve linear equations and pairs of simultaneous linear equations

- 8.EE 7: Solve linear equations in one variable.

Number and Quantity

Reason quantitatively and use units to solve problems

- N-Q 1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and origin in graphs and data displays.
- N-Q 2: Define appropriate quantities for the purpose of descriptive modeling.
- N-Q 3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Algebra

- A-SSE 1: Interpret expressions that represent a quantity in terms of its context.
- A-CED 3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
- A-CED 4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Geometry

Experiment with transformations in the plane.

- G-CO 1: Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

Make geometric constructions.

- G-CO 12: Make formal geometric constructions with a variety of tools and methods.

Define trigonometric ratios and solve problems involving right triangles.

- G-SRT 6: Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
- G-SRT 7: Explain and use the relationship between the sine and cosine of complementary angles.

Circles

- G-C 1: Prove that all circles are similar.
- G-C 2: Identify and describe relationships among inscribed angles.
- G-C 5: Derive using similarity that fact that the length of the arc intercepted by an angle is proportional to the radius.

Geometric Measurement and Dimension

- G-GMD 3: Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

Modeling with Geometry

- G-MG 1: Use geometric shapes, their measures, and their properties to describe objects.
- G-MG 2: Apply concepts of density based on area and volume in modeling situations.
- G-MG 3: Apply geometric methods to solve design problems.

DISTRICT ESLRS TO BE ADDRESSED:

- **Self Directed Learners**- WELD140 allows for students to process the application and reasoning behind the mathematics involved in the field of welding.
- **Constructive Thinkers**- WELD 140 demands constructive thinking as a process to formulate appropriate responses to welding challenges mathematically.
- **Effective Communicators**- WELD 140 requires effective communication skills when dealing with technical drawings, multi-tiered fabrication, and coordination of projects.
- **Collaborative Workers**- WELD 140 requires students collaborate as they attempt to problem solve as a group or as part of a production team in the field of welding.
- **Quality Producers/Performers**- WELD 140 demands quality production because the misuse of these mathematical practices could result in personal injury or death.
- **Responsible Citizens**- Completion of the WELD 140 class is the start of a journey through a trade program that supports the fabric of a community by being a responsible worker and contributing member of society.