

**EL DORADO UNION HIGH SCHOOL DISTRICT  
EDUCATIONAL SERVICES  
Course of Study Information Page**

COURSE TITLE <b>Manufacturing and Engineering Technology</b>			
DISTRICT COURSE NUMBER <b>#0516</b>		4-DIGIT STATE COURSE CODE (COMPLETED BY SILT) <b>5635</b>	
Rationale:	Manufacturing and Engineering are growing fields offering high wage careers. Between 2011 and 2012 Engineering has shown a 14.5% growth in our region with production jobs increasing 28.2% during the same time period according to the CA EDD. In this field technicians help mechanical engineers design, develop, test, and manufacture mechanical devices, including tools, engines, and machines. They may make sketches and rough layouts, record and analyze data, make calculations and estimates, and report their findings. Students graduating with training in manufacturing and engineering will be better prepared to compete for positions in this job market.		
Course Description that will be in the Course Directory:	This course represents a contextualized, laboratory-based, integrated curriculum opportunity for all high school students to learn about drafting and design, Machining and forming, welding and materials joining, and product innovation and design. Students will develop critical thinking skills through a variety of multimodal, problem-solving techniques. Students will gain hands-on skills in basic machine shop practices, measurement systems, shop safety practices, drilling machines, grinding machines, and milling machines. The integrated content focuses on competence in an age of rapidly advancing technology; and providing students with the basis for making wise academic and career choices.		
How Does this Course align with or meet State and District content standards?	This course is aligned with the Engineering and Design sector of the Career Technical Education model curriculum standards set by the California State Board of Education in January 2013 as well as the CA Manufacturing and Product Development Pathway Standards.		
NCLB Core Subjects:	<i>Select up to two that apply:</i> <input type="checkbox"/> Arts <input type="checkbox"/> Civics and Government <input checked="" type="checkbox"/> Not Core Subject <input type="checkbox"/> Economics <input type="checkbox"/> History <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input type="checkbox"/> Foreign Language <input type="checkbox"/> Reading / Language Arts <input type="checkbox"/> Geography <input type="checkbox"/> Science		
CDE CALPADS Course Descriptors:  (See Page 2 for Definitions)	CTE TECH PREP COURSE INDICATORS <input type="checkbox"/> Tech Prep (32) (Higher Ed) <input type="checkbox"/> Tech Prep & ROP(33) (Higher Ed) <input type="checkbox"/> ROP (30) <input checked="" type="checkbox"/> N/A	CTE COURSE CONTENT CODE <input type="checkbox"/> CTE Introductory (01) <input checked="" type="checkbox"/> CTE Concentrator (02) <input type="checkbox"/> CTE Completer (03) <input checked="" type="checkbox"/> Voc Subject Engineering and Design  <input type="checkbox"/> N/A	INSTRUCTIONAL LEVEL CODE <input type="checkbox"/> Remedial (35) <input type="checkbox"/> Honors UC-Certified (39) <input type="checkbox"/> Honors Non UC-Certified (34) <input type="checkbox"/> College (40) <input checked="" type="checkbox"/> N/A
Length of Course:	<input checked="" type="checkbox"/> Year <input type="checkbox"/> Semester		
Grade Level(s):	<input checked="" type="checkbox"/> 9 <input checked="" type="checkbox"/> 10 <input checked="" type="checkbox"/> 11 <input checked="" type="checkbox"/> 12		
Credit:	<input checked="" type="checkbox"/> Number of credits: <b>10</b> <input checked="" type="checkbox"/> Meets graduation requirements (subject <u>Elective</u> ) <input type="checkbox"/> Request for UC "a-g" requirements CSU/UC requirement		<input type="checkbox"/> College Prep

Prerequisites:	Recommended Engineering Design and Architecture 1
Department(s):	CTE
District Sites:	Oak Ridge High School
Board of Trustees COS Adoption Date:	June 10, 2014
Textbooks / Instructional Materials:	Mastercam Software Handbook
Funding Source:	Site, CTE, Perkins
Board of Trustees Textbook Adoption Date:	

### Definitions

CALPADS	California Longitudinal Pupil Achievement Data System
CTE Technical Prep	A course within a CTE technical career pathway or program that has been articulated with a postsecondary education or through an apprenticeship program of at least 2 years following secondary instruction.
Instructional Level Code	Represents a nonstandard instructional level at which the content of a specific course is either above or below a 'standard' course instructional level. These levels may be identified by the actual level of instruction or identified by equating the course content and level of instruction with a state or nationally recognized advanced course of study, such as IB or AP.
Instructional Level Honors, UC Certified	Includes all AP courses.
Instructional Level Honors, non UC Certified	Requires Board approval.
Instructional Level College	Includes ACE courses. Equivalent to college course and content, but not an AP course. Not related to section, but to course.



## EDUCATIONAL SERVICES

Department: **Career and Technical Education**

Course Title: **Manufacturing and Engineering Technology**

Course Number: **#0516**

Unit Title: **Unit #1: Drafting and Design**

**Content Area Standards :**

California Career Technical Education Standards, Engineering and Architecture Pathway Standards, Engineering Design Pathway

- C1.0 Interpret the development of graphic language in relation to engineering design.
- C2.0 Understand the effective use of engineering design equipment.
- C3.0 Understand the sketching process used in concept development.
- C4.0 Understand measurement systems as they apply to engineering design.
- C5.0 Use proper projection techniques to develop orthographic drawings.
- C6.0 Understand the applications and functions of sectional views.
- C7.0 Understand the applications and functions of auxiliary views.
- C8.0 Understand and apply proper dimensioning standards to drawings.
- C9.0 Understand the tolerance relationships between mating parts.
- C10.0 Understand the methods of applying text to a drawing.
- C11.0 Understand the methods of creating both written and digital portfolios.

**Unit Outline:** A detailed descriptive summary of all topics covered in the unit. Explain what the students will learn, know and be able to do.

This unit provides learning opportunities for students interested in preparing for careers in the design and production of visual communications.

Students will:

1. Apply conventional engineering design equipment procedures accurately, appropriately, and safely
2. Produce proportional two- and three-dimensional sketches and designs.
3. Know how the various measurement systems are used in engineering drawings
4. Develop multiview drawings using the orthographic projection process.
5. Clarify hidden features of an object using a sectional view and appropriate cutting planes
6. Know a variety of drafting applications and understand the proper dimensioning standards for each.
7. Use tolerancing in an engineering drawing.
8. Plan, prepare, and interpret drawings and models through traditional drafting or computer-aided design
9. (CAD) techniques.
10. Develop a binder or digital portfolio representative of completed work for presentation.
11. Give an effective oral presentation of a portfolio.

**Instructional Strategies:** Indicate how the Instructional Strategies support the delivery of the curriculum and the course goals. Indicate how assignments support the Common Core State Standards.

Instructional Strategies Include:

- Lecture
- Guided Practice
- Demonstration
- Student Based Enterprise
- Individual and Group Projects
- Curriculum Relevance Maintained as a Result of Advisory Committee Input
- Formative, Interim, and Summative Assessment

**Assessments:** Describe the Formative and Summative assessments that will be used to demonstrate learning and mastery of the standards:

Formative Assessment:

- Incremental Assessment of Project Development

Summative Assessment:

- Unit Exams
- Final Evaluations of Individual and Group Projects
- Final Written and/or Practical Examination

**Interventions:** Describe methods used to support students who fail to master unit formative and summative assessments.

- Hands-on labs will allow the teacher the opportunity to identify students who are struggling and provide one-on-one instruction.
- Peer instruction
- Establish a “retake” policy for tests and quizzes when a student scores below 75% or below 90% on a safety, content, or performance assessment.

EL DORADO UNION HIGH SCHOOL DISTRICT

EDUCATIONAL SERVICES

Department: **Career and Technical Education**

Course Title: **Manufacturing and Engineering Technology**

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Unit Title: **Unit #2 Machining and Forming Technologies**

**California CTE Content Area Standards :**

California Career Technical Education Standards, Machining and Forming Technologies Pathway

- B1.0 Validate that a provided part meets specifications from its engineering drawing by comparing specifications and by demonstrating proper technique using appropriate precision measuring tools.
- B2.0 Describe and layout a project according to specifications or engineering drawings. Demonstrate proper technique with layout tools and work-holding devices such as three- and four-jaw chucks, collet chucks, angle plates, sine bars, parallels, and v-blocks to machine a real part.
- B3.0 Research and compare the properties of two metals using two different material specifications and a process specification.
- B4.0 Demonstrate saw operation (Abrasive Cut Off, Cold Saw, Band Saw) to produce a length of bar stock to specification.
- B5.0 Demonstrate bending, shaping, other metal forming, and fabrication techniques, including processes such as basic hand filing, knurling on a lathe, forging metal shapes or objects, green sand/Pedro Bond casting, sheet metal machines, spot welding equipment or rivets, cold form bending with cold forming machinery or homemade devices, and shapes (tooling) to achieve a specific design specification.
- B6.0 Identify and select the right grinding wheel; perform wheel dressing; and grind the provided part/material to the size and surface finish specifications provided.
- B7.0 Perform a series of routine boring operations from a set of specifications or a drawing and explain the selection of proper tools (drill, reamer, countersink, spot facer, counter bore, tap, and center drill) for each step of the process.
- B8.0 Describe and demonstrate the machining of an external and internal taper, knurled part, and threaded and bored part on an engine lathe to plan specification or drawing to produce a part.
- B9.0 Produce parts to specification using a boring head or angular cutting with a sine bar, a keyway, and pockets with a typical vertical mill.
- B10.0 Produce parts to specifications or drawings provided on a computer numerical controlled (CNC) mill or lathe. Demonstrate common functions or controls through manual input and through programmed (stored) input. Introduce basic G and M Code Programming focusing on the use of the Cartesian coordinate system and machine axis. Using CAD generated geometry create tool path code using MasterCAM.

**Unit Outline:** A detailed descriptive summary of all topics covered in the unit. Explain what the students will learn, know and be able to do.

This unit provides students with an understanding of manufacturing processes and systems common to careers in machine tool and materials forming industries. Representative topics include trade vocabulary; shop math; basic material identification; proper use of hand and machine tools; reading precision measuring tools within .001" and the interpretation of machined and formed-part prints; the cutting, shaping, fastening, and finishing of machined parts; fixtures: forging, molding (casting), cold forming, and shearing processes.

Students will:

1. Describe and demonstrate grinding a high speed lathe tool bit focusing on the tool cutting geometry and tip radius, speeds and feeds for the materials being cut and using their tool bit and precision measuring tool, machine a part within specifications.
2. Discuss and demonstrate the wide variety of metal cutting hand files: materials, sizes, shapes, cuts, and tooth configurations.
3. Complete a layout project using a detailed set of sequential instructions to manufacture the project to plan specifications.
4. Perform secondary operations on each hole to specification including: reaming, countersinking, counter boring, tapping, and deburring.
5. Complete a layout project using a detailed set of sequential instructions to manufacture the project to plan specifications.
6. Set up and safely operate a vertical milling machine.
7. Discuss and demonstrate the setup and safe operation of a CNC turning or milling center: the setup of tools in tool holders; referencing the vice or chuck to the machine's control; and referencing the cutting tool to the machine's control.
8. Convert a provided three-dimensional (3-D) or computer-aided design (CAD) data set to a set of machine instructions (G code) using MasterCAM and then run the program producing the part to specifications provided. (Solids Modeling using Solid Works Inventor)
9. Perform continuous online quality control inspections of machined and formed parts.
10. Evaluate and know how to troubleshoot performance problems of machined and formed parts.

**Instructional Strategies:** Indicate how the Instructional Strategies support the delivery of the curriculum and the course goals. Indicate how assignments support the Common Core State Standards.

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Summative Assessment:

- Final Evaluations of Individual and Group Projects
- Final Written and/or Practical Examination

**Interventions:** Describe methods used to support students who fail to master unit Formative and Summative assessments:

- Provide Additional Student/Teacher Contact Time and Access to the Laboratory
- "Pay the Knowledge Forward" Advanced Students are Expected to Mentor Students Who Need Additional Support
- Students are Given Modified Assignment to Meet Their Individuals Capabilities and Learning Styles

EL DORADO UNION HIGH SCHOOL DISTRICT

EDUCATIONAL SERVICES

Department: **Career and Technical Education**

Course Title: **Manufacturing and Engineering Technology**

Course Number: **#0516**

Unit Title: **Unit #3 Welding and Materials Joining**

**California CTE Content Area Standards** : California Career Technical Education Standards, Machining and Product Development Pathway and American Welding Society (AWS) EG2.0 Guidelines for the Entry Level Welder.

C1.0 Interpret and demonstrate the planning and layout operations used in the welding processes.

C2.0 Understand and demonstrate how materials can be processed through the use of welding tools and equipment.

C3.0 Differentiate and apply various types of welding assembly processes.

C4.0 Understand finishing processes and the differences between various types of finishing materials used in the manufacture of welded parts and products.

C5.0 Understand and defend the purposes and processes of inspection and quality control in welding manufacturing processes.

C6.0 Explore and understand various welding systems that require standard hand and machine tools.

C7.0 Understand various automated welding systems, welding design for manufacturing, flexible manufacturing systems, and materials resource planning.

C8.0 Understand various joining or combining processes, including welding processes used in manufacturing, maintenance, and repair.

C9.0 Understand how a manufacturing company is organized and the elements of welding production management.

**Unit Outline:** A detailed descriptive summary of all topics covered in the unit. Explain what the students will learn, know and be able to do.

This unit will provide students with an understanding of manufacturing processes and systems common to careers in welding and related industries. Representative topics include the interpretation and layout of welded and assembled-part prints, cutting, mechanical bonding, joining, cohesive bonding, adhesive bonding, and mechanical fastening.

Students Will:

1. 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.
2. Analyze welding symbols on drawings, specifications, and welding procedure specifications.
3. Use welding tools and equipment such as oxy fuel welding (OFW), shielded metal arc welding (SMAW), gas metal arc welding (GMAW), flux-cored arc welding (FCAW), gas tungsten arc welding (GTAW), forge, and furnace to combine or join manufactured parts and products resulting in a finished product that meets the standards of the AWS or a similar industry standard.
4. Compare and contrast the physical qualities of various industrial materials and how these qualities affect the ability of the materials to be processed to produce useful welded parts and products.
5. Analyze and identify the steps to check for distortion, joint misalignment, and poor fit-up before and after welding.
6. Use computers to design and produce welded products, write numerical control programs, and control robots.



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Unit Title: **Unit #4 Product Innovation and Design**

**California CTE Content Area Standards** : California Career Technical Education Standards, Product Innovation and Design Pathway

- D1.0 Understand the basic product design and development process as it relates to the design of a product, line of products, system design, or services.
- D2.0 Understand and apply research methodologies as a means to identify a need, problem, or opportunity for a new product, product line, system design, or service.
- D3.0 Understand and apply various ideation techniques to develop ideas and concepts.
- D4.0 Apply various two-dimensional (2-D) graphic and/or three-dimensional (3-D) modeling techniques to development concept.
- D5.0 Develop the concept into a well-defined product for prototyping.
- D6.0 Produce a prototype of a product.
- D7.0 Evaluate the prototype to determine if it meets the requirements and objectives.
- D8.0 Understand and apply basic business and entrepreneurial principles and identify potential markets and/or other business opportunities for distribution of the product.
- D9.0 Produce a package design concept for a product or line of products.
- D10.0 Produce a presentation of the product, product line, system design, or service.

**Unit Outline:** A detailed descriptive summary of all topics covered in the unit. Explain what the students will learn, know and be able to do.

This unit provides students with an understanding of the design and manufacturing technologies common to careers in the fields of product design and manufacturing. Representative topics include the product design and development process, the principles of design, computer aided design, fabrication and manufacturing processes, sustainability, and the principles of business, entrepreneurship, and global design.

Students will:

1. Apply and identify the various phases of the product design development process to an existing product, product line, system design, or service.
2. Apply ideation techniques to explore and produce multiple concepts.
3. Create a preliminary design of a product concept utilizing drawing, computer software (Solid Works or Inventor), and/or 3D Printing conceptual model fabrication techniques.
4. Identify materials, mechanisms, technologies, and other requirements (e.g., safety, manufacturing, sustainability) the concept may require.
5. Produce technical drawings and other specifications required for the prototyping or manufacturing of the product.
6. Build a looks-like, works-like prototype of the model using the appropriate fabrication, manufacturing, or reproduction techniques or technologies such as 3D Printing.

7. Create a performance criteria and a quality standard to measure and evaluate a prototype.
8. Create a packaging concept utilizing drawing computer software (graphic or CAD).
9. Create a presentation of the design solution (e.g., product, product line, system design, or service) that effectively communicates its features and benefits.

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