Escondido Union High School District

Advanced Manufacturing

EUHSD Board Approval Date: 5/16/17
The EUHSD Advanced Manufacturing curriculum document identifies what students should be able to know by grade level in a comprehensive standards-based course of study. The curriculum document is updated annually based on student academic achievement data, research and best practices, and input from stakeholders. The EUHSD curriculum document contains the following documents and/or information:

A. Course Description
B. Course Guidelines/Requirements - graduation credit information, transcript information, adopted materials, adopted technology, assessment outline
C. Instructional Materials References
D. Scope and Sequence Map with Essential Standards outlined by Unit
E. References to key essential design and implementation documents

A comprehensive course of study and/or program is designed so that all students have access to the rigorous curriculum necessary to graduate high school demonstrating college and career readiness skills. Student-Centered learning provides opportunity for collaboration, communication, and a robust learning environment and provides opportunities for all students to meet the goals of the district’s Instructional Focus at the time of this writing: “All students communicate their thinking, ideas and understanding by effectively using oral, written and/or non-verbal expression.”

A key design consideration in the transition to the new California State Standards is a focus on changes to pedagogy. The English Language Arts instructional shifts guide classroom teaching and learning and the foundation of curriculum and instructional design. Key considerations of the ELA Instructional shifts can be found by visiting the following URL: http://www.corestandards.org/other-resources/key-shifts-in-english-language-arts/

The curriculum document is aligned to the California Model Career Technical Education Standards and reflects learning outcomes from both the anchor and pathway standards.
Advanced Manufacturing Course Description

Advanced Manufacturing provides advanced-level training in Manufacturing occupations. Building on skills acquired in previous Manufacturing coursework, students will become fully proficient in operating CNC mills and lathes. Students will learn how to create industry-level drawing using Computer Aided Design (CAD) software and convert their drawings to G- and M- code machining language using Computer Aided Machining (CAM) software. Students will have the opportunity to earn industry credentials from the National Institute for Metalworking Skills (NIMS) on the CNC vertical milling machine and CNC lathe.

The Machining and Forming Technologies course pathway is designed to introduce students to precision machining and automated machining. Its goal is to prepare students with skills to shape metal parts on machines such as lathes, grinders, drill presses, and milling machines. The pathway contains three (4) one-year courses: Introduction to Manufacturing, Manufacturing I, Manufacturing II, and Advanced Manufacturing. As students complete each course, they will be qualified for several entry-level jobs including: Shop Assistant, Apprentice Machinist, Beginning Machinist, CNC Operator, Engine and Machine Assembler, Patternmaker, Tool and Die Maker, Model Maker, and Tool Sharpener. All students will have the opportunity to earn machining credentials through the National Institute for Metalworking Skills (NIMS) at no cost to them. These are machining credentials which industry recognizes (and prefers) when hiring new employees.

Course Requirements

<table>
<thead>
<tr>
<th>Course Length: Year Long</th>
<th>Grade Level: 10-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC/CSU Requirement: Meets UC/CSU “g” requirement</td>
<td>Graduation Requirement: EUHSD CTE Requirement or Elective Credit</td>
</tr>
<tr>
<td>Course Number (Semester A): 6447</td>
<td>Transcript Abbreviation (Semester A): MANUFACT (ADV) A (P)</td>
</tr>
<tr>
<td>Course Number (Semester B): 6448</td>
<td>Transcript Abbreviation (Semester B): MANUFACT (ADV) B (P)</td>
</tr>
<tr>
<td>Credits (Semester A): 5 CTE or Elective</td>
<td>Credits (Semester B): 5 TEC or Elective</td>
</tr>
<tr>
<td>Required Prerequisite/s: Grade of “C” or better in Manufacturing 2</td>
<td>Recommended Prerequisite/s: None</td>
</tr>
<tr>
<td>Industry Sector: Manufacturing and Product Development</td>
<td>Career Pathway: Machining and Forming Technologies</td>
</tr>
<tr>
<td>Board Approval Date (Curriculum): 5/16/17</td>
<td>Board Approval Date (Materials):</td>
</tr>
</tbody>
</table>

Core Instructional Material/s:

Each unit of study requires a different set of resources. There is no core instructional book for this course.

Supplemental Instructional Material/s:
- *Precision Machining Technology* by Hoffman, et. al., NIMS Press ©2012 (Class set)
- *Machinery’s Handbook, Pocket Companion 30th Edition* by Christopher McCauley (Class set)

Technology Resource/s: Teachers will utilize a variety of equipment in the work/lab space.

Assessment/s: The course is designed as a project based curriculum. Each unit outlines specific skills and/or long term projects which serve as unit and course assessments.
The Scope and Sequence Guide is a California standards based document that delineates the standards based skills students are expected to know and do in order to meet College and Career Readiness expectations. Each unit of study in the Scope and Sequence document is designed to build upon the previous unit and/or prerequisite coursework in support of student mastery of specific standards based skills. The Scope and Sequence document provides the framework of understanding for key assignments, key assessments, and instructional resources and strategies that serve to assist students in meeting unit learning objectives. The document will be updated annually with input from all stakeholders.

In coursework requiring reading and writing, the following standards are not specifically stated in any one unit of study, but are the result of implementation throughout the curriculum as students participate in reading, writing, and speaking/listening standards based activities.

- **By the end of grade 11, students will read and comprehend literary nonfiction in the grades 11-CCR text completely hand proficiently, with scaffolding as needed at the high range.** (Reading Informational Text Standard 10)
- **Students will write routinely over extending time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks and purposes.** (Writing Standard 10)
- **’To be college and career ready, students must have ample opportunities to take part in a variety of rich and structured conversations – as part of a whole class, in small groups, and with a partner – build around important content in various domains. They must be able to contribute appropriately to conversations, make comparisons and contrasts, and analyze and synthesize a multitude of ideas according to the standards of evidence appropriate to a particular discipline.’** (Standards for ELA Anchor Standards for Speaking/Listening)

The following CTE anchor standards are not specifically stated in any one unit of study, but are reflected as skills and practices throughout the curriculum.

- **MPD Anchor 4.0 Technology** Use existing and emerging technology. to investigate, research, and produce products and services, including new information, as required in the Manufacturing and Product Development sector workplace environment. (Direct alignment with WS 11-12.6)

- **MPD Anchor 6.0 Health and Safety:** Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Manufacturing and Product Development sector workplace environment. (Direct alignment with RSTS 9-10, 11-12.4)

- **MPD Anchor 10.0 Technical Knowledge and Skills:** Apply essential technical knowledge and skills common to all pathways in the Manufacturing and Product Development sector, following procedures when carrying out experiments or performing technical tasks. (Direct alignment with WS 11-12.6)

- **MPD Anchor 11.0 Demonstration and Application:** Demonstrate and apply the knowledge and skills contained in the Manufacturing and Product Development anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and through the Skills USA career technical student organizations.
## Advanced Manufacturing - Scope and Sequence
### Unit 1 – Workshop Safety
#### Length: 2 Weeks

**Unit Description:** In Unit 1, students will review specific safety and use policies, procedures, and practices. They will examine work spaces for safety and/or health concerns. They will be expected to demonstrate a variety of safety practices through various classroom assignments and activities and will demonstrate their understanding through completion of a required safety test. Many of the skills and procedures acquired in Unit 1 will be built upon in subsequent units of study.

<table>
<thead>
<tr>
<th>Manufacturing and Product Development Knowledge and Performance Anchor Standards:</th>
<th>Learning Objectives:</th>
<th>Unit Assignments:</th>
<th>Unit Assessments:</th>
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<tbody>
<tr>
<td>The Anchor standards below serve as the overarching skills and competencies for each pathway within the industry sector. The skills are repeated throughout each unit of study.</td>
<td>Students will be able to...</td>
<td>Students will take a multiple choice safety test and pass the test with 90% accuracy prior to utilizing equipment and/or working in the shop area. All wrong questions will be written out with the correct answers, and will contain reasoning as to why the correct answer is appropriate. Students will review the housekeeping/clean-up plan for the machine shop and review its effectiveness, making necessary changes to the jobs and duties as needed. Students will create a digital portfolio where they will house all of their projects and will use this space to keep notes, worksheets, and other project specific tasks used throughout the course.</td>
<td>Written safety test with 100% correct responses Revised version of the workshop’s clean-up plans, assigned roles, and responsibilities</td>
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<tr>
<td>2.1 Recognize the elements of communication using a sender–receiver model. 2.2 Identify barriers to accurate and appropriate communication. 2.3 Interpret verbal and nonverbal communications and respond appropriately. 2.4 Demonstrate elements of written and electronic communication such as accurate spelling, grammar, and format. 2.5 Communicate information and ideas effectively to multiple audiences using a variety of media and formats. 2.6 Advocate and practice safe, legal, and responsible use of digital media information and communications technologies. 3.2 Evaluate personal character traits such as trust, respect, and responsibility and understand the impact they can have on career success. 3.3 Explore how information and communication technologies are used in career planning and decision making. 4.1 Use electronic reference materials to gather information and produce products and services. 4.3 Use information and communication technologies to synthesize, summarize, compare, and contrast information from multiple sources.</td>
<td>• Explain what a Material Safety Data Sheet is, where to access it, and how to apply its information to enhance personal safety. • Use a workshop protocol document to know what they are responsible for in the workshop. • Properly store, clean, maintain tools, equipment and supplies. • Safely set up their work areas to avoid health hazards and injuries. • Demonstrate safe and proper techniques when moving equipment and supplies. • Demonstrate how to prevent and respond to work related accidents or injuries and emergencies. • Maintain a safe and healthful work environment. • Recall 2-3 OSHA laws which pertain to worker safety. • Review text and determine the central idea.</td>
<td>• Students will review the housekeeping/clean-up plan for the machine shop and review its effectiveness, making necessary changes to the jobs and duties as needed. Students will create a digital portfolio where they will house all of their projects and will use this space to keep notes, worksheets, and other project specific tasks used throughout the course.</td>
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4.4 Discern the quality and value of information collected using digital technologies, and recognize bias and intent of the associated sources.

4.6 Assess the value of various information and communication technologies to interact with constituent populations as part of a search of the current literature or in relation to the information task.

5.1 Identify and ask significant questions that clarify various points of view to solve problems.

5.2 Solve predictable and unpredictable work-related problems using various types of reasoning (inductive, deductive) as appropriate.

5.3 Use systems thinking to analyze how various components interact with each other to produce outcomes in a complex work environment.

5.4 Interpret information and draw conclusions, based on the best analysis, to make informed decisions.

6.1 Locate, and adhere to, Material Safety Data Sheet (MSDS) instructions.

6.2 Interpret policies, procedures, and regulations for the workplace environment, including employer and employee responsibilities.

6.3 Use health and safety practices for storing, cleaning, and maintaining tools, equipment, and supplies.

6.4 Set up a work area, or shop, to avoid potential health concerns and safety hazards including but not limited to ergonomics, electrical (shock), wires (tripping), fumes (lung health), noise (hearing loss), fire (burns), and so forth, incorporating ergonomics.

6.5 Practice personal safety when lifting, bending, or moving equipment and supplies.

6.6 Demonstrate how to prevent and respond to work-related accidents or injuries and emergencies.

6.7 Maintain a safe and healthful working environment.

6.8 Be informed of laws/acts pertaining to the Occupational Safety and Health Administration (OSHA).

7.2 Explain the importance of accountability and responsibility in fulfilling personal, community, and workplace roles.

- Follow precise instructions and perform technical tasks.
- Determine meaning of key symbols.
- Integrate information from various sources.
- Use technology to research, produce (when applicable), and respond to information.
- Conduct short and more sustained research on a variety of topics.
- Work independently and within small and large groups.
- Use communication skills, orally and written, to convey ideas to others. (Speaking and Listening)
7.3 Understand the need to adapt to changing and varied roles and responsibilities.
7.4 Practice time management and efficiency to fulfill responsibilities.
7.5 Apply high-quality techniques to product or presentation design and development.
7.7 Demonstrate the qualities and behaviors that constitute a positive and professional work demeanor, including appropriate attire for the profession.
8.1 Access, analyze, and implement quality assurance standards of practice.
8.3 Demonstrate ethical and legal practices consistent with Manufacturing and Product Design sector workplace standards.
8.4 Explain the importance of personal integrity, confidentiality, and ethical behavior in the workplace.
8.5 Analyze organizational culture and practices within the workplace environment.
8.6 Adhere to copyright and intellectual property laws and regulations, and use and appropriately cite proprietary information.
9.1 Define leadership and identify the responsibilities, competencies, and behaviors of successful leaders.
9.2 Identify the characteristics of successful teams, including leadership, cooperation, collaboration, and effective decision-making skills as applied in groups, teams, and career technical student organization activities.
9.3 Understand the characteristics and benefits of teamwork, leadership, and citizenship in the school, community, and workplace setting.
9.6 Respect individual and cultural differences and recognize the importance of diversity in the workplace.
9.7 Participate in interactive teamwork to solve real Manufacturing and Product Design sector issues and problems.
10.1 Interpret and explain terminology and practices specific to the Manufacturing and Product Design sector.
10.2 Comply with the rules, regulations, and expectations of all aspects of the Manufacturing and Product Design sector.
10.3 Construct projects and products specific to the Manufacturing and Product Design sector requirements and expectations.
11.2 Demonstrate proficiency in a career technical pathway that leads to certification, licensure, and/or continued learning at the postsecondary level.
11.5 Create a portfolio, or similar collection of work, that offers evidence through assessment and evaluation of skills and knowledge competency as contained in the anchor standards, pathway standards, and performance indicators

**Manufacturing and Product Development Pathway Standards:**
6.1 Locate, and adhere to, Material Safety Data Sheet (MSDS) instructions.
6.2 Interpret policies, procedures, and regulations for the workplace environment, including employer and employee responsibilities.
6.3 Use health and safety practices for storing, cleaning, and maintaining tools, equipment, and supplies.
6.4 Set up a work area, or shop, to avoid potential health concerns and safety hazards including but not limited to ergonomics, electrical (shock), wires (tripping), flames (lung health), noise (hearing loss), fire (burns), and so forth, incorporating ergonomics.
6.5 Practice personal safety when lifting, bending, or moving equipment and supplies.
6.6 Demonstrate how to prevent and respond to work-related accidents or injuries and emergencies.
6.7 Maintain a safe and healthful working environment.
6.8 Be informed of laws/acts pertaining to the Occupational Safety and Health Administration (OSHA).
### Meeting the Needs of ELs:

- Utilize the student information system to acquire the language levels of EUHSD English Learners.
- In 2012, the CA Department of Education adopted new language level proficiency descriptors and new EL state standards. Visit the following website to learn more about those new descriptors and corresponding standards: [http://www.cde.ca.gov/sp/el/er/documents/eldstdspub14.pdf](http://www.cde.ca.gov/sp/el/er/documents/eldstdspub14.pdf)
- In 2014, the CA Department of Education adopted new ELA-ELD Framework, with specific strategies designed to meet the needs of EL students. Visit the following URL to learn more about the new frameworks: [http://www.cde.ca.gov/ci/rl/cf/documents/elaeldfwchapter11.pdf](http://www.cde.ca.gov/ci/rl/cf/documents/elaeldfwchapter11.pdf)

### Instructional Resources:

- **Precision Machining Technology** Unit 1
- [www.osha.gov](http://www.osha.gov)
- [www.youtube.com](http://www.youtube.com)
- Safety Manual

### Instructional Strategies:

- Teacher led Lecture
- Video demonstrations
- Group work and/or pair work
- Differentiate vocabulary or use of glossary
- Teacher led demonstrations on all equipment prior to safety tests
- Use of instructional notebooks
Advanced Manufacturing - Scope and Sequence  
Unit 2 – Materials and Measurement  
Length: 3 Weeks

**Unit Description:** In Unit 2, students will review technical drawings and practice performing various precision measurements, enabling them to select appropriate project parameters. Students will participate in several hands-on assessments that are designed to demonstrate abilities in standard precision measurements.

<table>
<thead>
<tr>
<th>Manufacturing and Product Development Pathway Standards:</th>
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| B1.0 Validate that a provided part meets specifications from its engineering drawing by comparing specifications (geometric dimensioning and tolerancing) and by demonstrating proper technique using appropriate precision measuring tools. B1.1 Identify and describe how the isometric and the orthographic views and the tolerance, scale, and material from an engineering drawing are used with an actual part. B1.2 Demonstrate the correct use of precision measuring tools such as vernier and dial calipers, height gages, and micrometers utilizing both English and Metric systems. B1.3 Demonstrate the correct use of a gage block (set) to check a part or to calibrate the accuracy of other precision measuring tools. B3.0 Research and compare the properties of two metals using two different material specifications and a process specification. B3.1 Classify the difference between ferrous and nonferrous metals and contrast low-, medium-, and high-carbon steels by their common uses in industry. B3.2 Describe both the alloys from their classification systems utilizing Unified Numbering System (UNS) or American Iron and Steel Institute-Society of Automotive Engineers (AIISAE) and explain how characteristics such as the Rockwell Hardness Test affect machining operations. B3.3 Demonstrate how to calculate, then revise the calculations, for spindle speed and feed rate, for both alloy examples, for either a vertical mill or a lathe. | Students will be able to…  
• Interpret technical drawings by locating dimensions and tolerances.  
• Create isometric and orthographic drawings from a representative object.  
• Use measuring tools to verify conformance of parts according to technical drawings.  
• Use the Machinery’s Handbook or other appropriate reference materials to determine a metal’s properties.  
• State the common applications for which various types of metals are chosen.  
• Explain how characteristics such as the Rockwell Hardness Test affect machining operations.  
• Calculate spindle speeds and feed rates for the vertical mill and lathe.  
• Review text and determine the central idea.  
• Determine the meaning of industry specific words and phrases and use industry terminology appropriately.  
• Follow precise instructions and perform technical tasks.  
• Determine meaning of key symbols. | Students will work individually and, at times, in pairs to create orthographic and isometric sketches using a real-life object. They will utilize industry requirements in order to evaluate the accuracy of their drawings. Assignments will be uploaded and/or hand created assignments will be placed into the student’s work portfolio for review.  
Students will complete a series of measurement tests designed to assess their understanding and mastery of basic measurements utilized throughout the course. This may be either a hands on and/or paper demonstration of understanding (fraction, inch, decimal inch, dial caliper, micrometer, etc.).  
Inspect all projects and complete an inspection report to indicate the degree of accuracy of the part(s).  
All students will complete a required end of unit exam on drawing views and interpretations, RPM and feed calculations. | Measurement Tests  
Materials and Measurement Unit Exam  
Ongoing performance assessments (direct observation within the workshops) by the teacher |
- Integrate information from various sources.
- Use technology to research, produce (when applicable), and respond to information.
- Conduct short and more sustained research on a variety of topics.
- Work independently and within small and large groups.
- Use communication skills, orally and written, to convey ideas to others. (Speaking and Listening)

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### Instructional Resources:

- **Precision Machining Technology** Section 2
- [www.youtube.com](http://www.youtube.com)
- **Basic Technical Drawing**, Chapters 2, 6, & 9

### Instructional Strategies:

- Teacher led Lecture
- Video demonstrations
- Group work and/or pair work
- Differentiate vocabulary or use of glossary
- Teacher led demonstrations on all equipment prior to safety tests
- Use of instructional notebooks
Advanced Manufacturing - Scope and Sequence
Unit 3 – Job Planning, Benchwork, and Layout
Length: 3 Weeks

Unit Description: In Unit 3, students will be able to understand engineering drawings, perform layout using hand tools, and use hand tools and power saws to perform secondary operations on a work piece after cutting it to size.

Unit Standards:

Manufacturing and Product Development
Pathway Standards:
B2.1 Describe and then contrast when to use work-holding fixtures, such as v-block, angle plate, toe clamp, vises, chucks, or custom fixtures.
B2.4 Use a surface plate, surface gage, height gage, prick and center punches, scriber, layout dye, and other appropriate tools to locate hole centers, radii, and locations matching the specifications provided.
B4.1 Using a length of bar stock and a process specification or drawing, cut a length of bar stock matching the cut list and demonstrate no sharp edges.
B4.2 Cut one steel bar and one aluminum plate determining the correct or optimal blade material (carbon steel, high speed, or bimetal), the proper sawtooth set to use for each, and explain why.
B5.1 Discuss and demonstrate the wide variety of metal cutting hand files: materials, sizes, shapes, cuts, and tooth configurations.
B5.2 Describe and demonstrate the care and use of the common file which can be used to form radii on a variety of commercially available metals or those that have been casted or forged.
B7.4 Research the proper material machinability and tooling recommendations from trade resources such as ‘Machinery’s Handbook’; choose the correct tool and holder; and calculate the spindle rpm and the feed rate for holes.
B7.5 Perform secondary operations on each hole to specification including: reaming, countersinking, counter boring, tapping, and deburring.
B7.6 Use a pin gage or thread gage to validate each hole or that a tapped thread meets specifications.

Learning Objectives:
Students will be able to…

• Use various tools to layout hole centers, radii, and locations matching the specifications provided.
• Accurately layout all the features found on the NIMS CNC Milling project (Job Duty 10.1) and the NIMS CNC Turning project (Job Duty 10.2).
• Safely cut lengths of bar stock according to cut lists resulting no sharp edges.
• Use various metal cutting hand files varying in materials, sizes, shapes, cuts, and tooth configurations.
• Properly care for metalworking files.
• Drill, tap, and ream holes according to specifications.
• Perform secondary operations on each hole to specification including: reaming, countersinking, counter boring, tapping, and deburring.
• Use a pin gage or thread gage to validate each hole or that a tapped thread meets specifications.
• Review text and determine the central idea.
• Determine the meaning of industry specific words and phrases and use industry terminology appropriately.

Unit Assignments:

Students will create Process Planning Worksheets for all projects (NIMS CNC Milling) which includes the order of operations, necessary tooling, and applicable machining speeds and feed rates. They will utilize industry requirements in order to evaluate the accuracy of their drawings. Assignments will be uploaded and/or hand created assignments will be placed into the student’s work portfolio for review.

Unit Assessments:

• NIMS CNC Milling Project (evaluated/graded by student then teacher)
• Ongoing performance assessments (direct observation within the workshops) by the teacher
• Follow precise instructions and perform technical tasks.
• Determine meaning of key symbols.
• Integrate information from various sources.
• Use technology to research, produce (when applicable), and respond to information.
• Conduct short and more sustained research on a variety of topics.
• Work independently and within small and large groups.
• Use communication skills, orally and written, to convey ideas to others. (Speaking and Listening)

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### Instructional Resources:

- *Precision Machining Technology*, Section 3
- *Machinery’s Handbook*
- [www.youtube.com](http://www.youtube.com)

### Instructional Strategies:

- Teacher led Lecture
- Video demonstrations
- Group work and/or pair work
- Differentiate vocabulary or use of glossary
- Teacher led demonstrations on all equipment prior to safety tests
- Use of instructional notebooks
### Advanced Manufacturing - Scope and Sequence
#### Unit 4 – Computer Aided Design

**Length:** 10 Weeks

**Unit Description:** In Unit 4, students will review the working parts of the engine lathe and will complete a series of hands-on demonstrations according to industry specifications. They will be expected to demonstrate and discuss all of the lathe’s component parts. Students will complete a Hex Nut Project, a Shoulder Bushing Project, a NIMS Turning Chucked and NIMS Turning Between Centers project according to industry specifications.

<table>
<thead>
<tr>
<th>Unit Standards:</th>
<th>Learning Objectives:</th>
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<th>Unit Assessments:</th>
</tr>
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</table>
| **Manufacturing and Product Development**<br>**Pathway Standards:**<br>B10.0 Produce parts to specifications or drawings provided on a computer numerical controlled (CNC) mill. 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.<br>B10.1 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.<br>B10.2 Demonstrate control panel commands to perform basic milling or turning commands for motion of the tool path along the coordinate axis.<br>B10.3 Convert a provided three-dimensional (3-D) or computer-aided design (CAD) data set to a set of machine instructions (G code) and then run the program producing the part to specifications provided.<br>B10.4 Demonstrate a tooling change and tool selection to complete a multistep process on a CNC milling or turning center.<br>B10.5 Produce a part with tight-radius pocket features by demonstrating proper cutting tool selection, proper tool-path, and proper speeds on a CNC milling machine. | **Students will be able to…**<br>• Select cutting tools for the vertical milling machine and lathe based on the type of material to be cut.<br>• Set the proper RPMs (cutting speeds) and feed rates for any given material.<br>• Produce various parts according to the specifications provided on blueprints/drawings.<br>• Review text and determine the central idea.<br>• Determine the meaning of industry specific words and phrases and use industry terminology appropriately.<br>• Follow precise instructions and perform technical tasks.<br>• Determine meaning of key symbols.<br>• Integrate information from various sources.<br>• Use technology to research, produce (when applicable), and respond to information.<br>• Conduct short and more sustained research on a variety of topics.<br>• Work independently and within small and large groups. | **Students will review the working parts on the engine lathe by completing a Machine Parts Matching worksheet and reviewing the parts with their peers.**<br>**Students will create a Process Planning Worksheet for all projects on the lathe which will include the order of operations, necessary tooling, and applicable machining speeds and feed rates. They will utilize industry requirements in order to evaluate the accuracy of their drawings. Assignments will be uploaded and/or hand created assignments will be placed into the student’s work portfolio for review.**<br>**Students will answer Workbook Section 8, Unit 8 questions entitled Computer-Aided Design and Computer-Aided Manufacturing in order to familiarize them with CAD/CAM programs and operation of machines.** | **Lathe Safety Test**<br>**Hex Nut Project** (evaluated/graded by student then teacher)<br>**Shoulder Bushing Project** (evaluated/graded by student then teacher)<br>**NIMS Turning (Chucked) Project** (evaluated/graded by student then teacher)<br>**NIMS Turning (Between Centers) Project** (evaluated/graded by student then teacher)<br>**Lathe Unit Exam**
<table>
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**Instructional Strategies:**

- Teacher led Lecture
- Video demonstrations
- Group work and/or pair work
- Differentiate vocabulary or use of glossary
- Teacher led demonstrations on all equipment prior to safety tests
- Use of instructional notebooks
**Advanced Manufacturing - Scope and Sequence**

**Unit 5 – CNC Milling**

**Length:** 9 Weeks

**Unit Description:** In Unit 5, students will develop the skills to perform fundamental operations of CNC Mills, emphasizing on the basic operation of the machinery, process, and shop safety.

**Unit Standards:**

<table>
<thead>
<tr>
<th>Manufacturing and Product Development Pathway Standards:</th>
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<tbody>
<tr>
<td>B10.0 Produce parts to specifications or drawings provided on a computer numerical controlled (CNC) mill. 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.</td>
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<tr>
<td>B10.1 Discuss and demonstrate the setup and safe operation of a CNC milling center: the setup of tools in tool holders; referencing the vice to the machine’s control; and referencing the cutting tool to the machine’s control.</td>
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<td>B10.2 Demonstrate control panel commands to perform basic milling commands for motion of the tool path along the coordinate axis.</td>
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<td>B10.3 Convert a provided three-dimensional (3-D) or computer-aided design (CAD) data set to a set of machine instructions (G code) and then run the program producing the part to specifications provided.</td>
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<td>B10.4 Demonstrate a tooling change and tool selection to complete a multistep process on a CNC milling center.</td>
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<tr>
<td>B10.5 Produce a part with tight-radius pocket features by demonstrating proper cutting tool selection, proper tool-path, and proper speeds on a CNC milling machine.</td>
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**Learning Objectives:**

Students will be able to…

- Recite and demonstrate essential safe operating and set up procedures on a CNC milling machine.
- Explain the basic tooling typically used in CNC milling operations with applications and considerations for both safety, efficiency, and quality.
- Perform basic functions on a CNC milling machine.
- Operate the control panel on a CNC mill and navigate through the various menus to perform setups and operation command.
- Execute the importing of CAM programs to a CNC milling machine.
- Perform preventive maintenance on a CNC milling machine by following a maintenance schedule.
- Manipulate a block of G-code and/or M-code to achieve desired results or correct an error in the original program.
- Use a CNC simulator to examine a CAM program graphically (code-based) and visually (animation-based).
- Review text and determine the central idea.
- Determine the meaning of industry specific words and phrases and use industry terminology appropriately.

**Unit Assignments:**

- Students will review the working parts on the vertical mill by completing a Machine Parts Matching worksheet.
- Students will create a Process Planning Worksheet for all projects which includes the order of operations, necessary tooling, and applicable machining speeds and feed rates.
- Students will complete Workbook Section 8, Units 1, 5, 6, and 7 questions entitled CNC Basics, Introduction to CNC Milling, CNC Milling: Programming, and CNC Setup and Operation, in order to familiarize them with the information regarding operating a CNC milling center.
- Students will be guided through the peer-to-peer Vertical Mill set-up and Milling Observation check list so they will be able to evaluate one another.
- Students will cut out raw stock, perform deburring operations, layout dimension and feature lines, machine away excess metal to produce parts to specific dimensions which are with tolerance, and perform finishing techniques to produce a complete part.
- Students will perform quality assurance measurements and inspections to ensure that their projects are made to specification in order to evaluate their own, as well as their peers'.

**Unit Assessments:**

- CNC Mill Safety Test
- NIMS CNC Mill Block Project (evaluated/graded by student then teacher)
- CNC Mill Unit Exam
- Follow precise instructions and perform technical tasks.
- Determine meaning of key symbols.
- Integrate information from various sources.
- Use technology to research, produce (when applicable), and respond to information.
- Conduct short and more sustained research on a variety of topics.
- Work independently and within small and large groups.
- Use communication skills, orally and written, to convey ideas to others. (Speaking and Listening)

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<tr>
<td>• Precision Machining Technology, Section 6: &quot;Milling&quot;</td>
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<td>• Machinery’s Handbook</td>
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Advanced Manufacturing - Scope and Sequence  
Unit 6 – CNC Turning & Career Planning  
Length: 9 Weeks

**Unit Description:** In Unit 6, students will develop the skills to perform fundamental operations of CNC Lathes, emphasizing the basic set-up and operation of the machinery, process, and shop safety. Students will also conduct an in-depth career planning exploration will create a resume and cover letter showcasing their knowledge and mastery of specific skills and competencies and will present their resume and cover letter at the end of the course.

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<th>Learning Objectives:</th>
<th>Unit Assignments:</th>
<th>Unit Assessments:</th>
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| 11.2 Demonstrate proficiency in a career technical pathway that leads to certification, licensure, and/or continued learning at the postsecondary level.  
11.3 Demonstrate entrepreneurship skills and knowledge of self-employment options and innovative ventures.  
11.4 Employ entrepreneurial practices and behaviors appropriate to Manufacturing and Product Design sector opportunities.  
11.5 Create a portfolio, or similar collection of work, that offers evidence through assessment and evaluation of skills and knowledge competency as contained in the anchor standards, pathway standards, and performance indicators. | **Students will be able to...**  
• Recite and demonstrate essential safe operating and set up procedures on a CNC turning machine.  
• Explain the basic tooling typically used in CNC turning operations with applications and considerations for both safety, efficiency, and quality.  
• Perform basic functions on a CNC turning machine.  
• Operate the control panel on a CNC mill and navigate through the various menus to perform setups and operation command.  
• Execute the importing of CAM programs to a CNC turning machine.  
• Perform preventive maintenance on a CNC turning machine by following a maintenance schedule.  
• Manipulate a block of G-code and/or M-code to achieve desired results or correct an error in the original program.  
• Use a CNC simulator to examine a CAM program graphically (code-based) and visually (animation-based).  
• Review text and determine the central idea. | **Students will learn the working parts on the CNC lathe by completing a Machine Parts Matching worksheet.**  
**Students will create a Process Planning Worksheet for all projects which includes the order of operations, necessary tooling, and applicable machining speeds and feed rates.**  
**Students will complete Workbook Section 8, Units 1, 2, 3, and 4 questions entitled CNC Basics, Introduction to CNC Turning, CNC Turning: Programming, and CNC Turning: Setup and Operation in order to familiarize them with the various tools used on the CNC Turning Center.**  
**Students will be guided through the peer-to-peer Vertical Mill set-up and Milling Observation check list so they will be able to evaluate one another.**  
**Students will cut out raw stock, perform deburring operations, layout dimension and feature lines, machine away excess metal to produce parts to specific dimensions which are with tolerance, and perform finishing techniques to produce a complete part.**  
**Students will perform quality assurance measurements and inspections to ensure that their projects are made to specification in order to evaluate their own, as well as their peers'.** | **CNC Lathe Safety Test**  
**NIMS CNC Lathe Spindle Practice Project (evaluated/graded by student then teacher)**  
**CNC Lathe Unit Exam**  
**Research project, resume cover letter, and portfolio.** |
- Determine the meaning of industry specific words and phrases and use industry terminology appropriately.
- Follow precise instructions and perform technical tasks.
- Determine meaning of key symbols.
- Integrate information from various sources.
- Use technology to research, produce (when applicable), and respond to information.
- Conduct short and more sustained research on a variety of topics.
- Work independently and within small and large groups.
- Use communication skills, orally and written, to convey ideas to others. (Speaking and Listening)

- Students will conduct online research exploring specific job competencies and skills related to the Manufacturing industry and pathway learning outcomes. They will utilize the WWW as well as conduct interviews with industry professionals in order to determine and prioritize a list of essential skills and qualifications for college and career readiness. Students will compile their research in a mini research notes portfolio, cite their sources, and will create a resume and cover letter showcasing the skills and competencies acquired during their experience in the courses within the pathway. They will present their resume and cover letter as part of their overall portfolio.

**Meeting the Needs of ELs:**

- Utilize the student information system to acquire the language levels of EUHSD English Learners.
- In 2012, the CA Department of Education adopted new language level proficiency descriptors and new EL state standards. Visit the following website to learn more about those new descriptors and corresponding standards:
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**Instructional Resources:**

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**Instructional Strategies:**

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- Video demonstrations
- Group work and/or pair work
- Differentiate vocabulary or use of glossary
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