FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT

ADVANCED PRODUCT INNOVATION DESIGN AND MANUFACTURING

Date: January 2017                                                                                                           Course Length: 1 Year
Proposed Grade Level(s): 10-12                                                   Subject Area: Career Technical Education
Grading: A-F                                                                   Credits: 5 per semester
CTE Sector / Pathway: Manufacturing and Product Development/Product Innovation and Design

Prerequisite(s): Introduction to Product Innovation Design and Manufacturing

Intent to Pursue ‘A-G’ College Prep Status: Yes

COURSE DESCRIPTION:

The course Advanced Product Innovation Design and Manufacturing builds upon skills and knowledge learned in Product Innovation Design and Manufacturing. This course will offer Sophomores, Juniors, and Seniors the opportunity to further advance their skill proficiencies in the areas of graphic design, machine tooling and forming, engineering design, project planning, tool fitting, and product innovation and design. Comprehensive understanding and application of current safety standards and procedures will be a component of each study unit. Career planning, project innovation, and entrepreneurship will be an integral part of the course.

GENERAL GOALS/ESSENTIAL QUESTIONS:

Goals:
- Apply an advanced understanding of the design process.
- Develop advanced proficiencies in the area of graphic design.
- Develop multiple working models.
- Engage in an advanced proficiency in the area of machine tooling and forming.
- Develop skills in the area of material identification and selection.
- Develop skills in the area of materials stress analysis.
- Develop a focus in one or more areas of industrial technology.
- Produce multiple, innovative products by applying appropriate design and manufacturing processes.

Essential Questions:
- Can students exhibit an advanced understanding of the design process?
- Can students show an advanced proficiency in graphic design, and develop multiple working models?
- Can students show skills in material identification, stress analysis, and selection?
- Can students show evidence of the development of a focus in the industrial technology pathway?
- Using design and manufacturing processes, can students produce multiple and innovative products?

COMMON CORE STATE ANCHOR STANDARDS FOR READING (K-12):

Key Ideas and Details
1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
3. Analyze how and why individuals, events, or ideas develop and interact over the course of a text.

**Craft and Structure**
4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
5. Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text (e.g., a section, chapter, scene, or stanza) relate to each other and the whole.
6. Assess how point of view or purpose shapes the content and style of a text.

**Integration of Knowledge and Ideas**
7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.

**Reading Range / Text Complexity**
10. Read and comprehend complex literary and informational texts independently and proficiently.

**COMMON CORE STATE ANCHOR STANDARDS FOR WRITING (K-12):**

**Text Types and Purposes**
1. Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.
2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
3. Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details and well-structured event sequences.

**Production and Distribution of Writing**
4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.
6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

**Research to Build Knowledge**
7. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.
8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
9. Draw evidence from literary or informational texts to support analysis, reflection, and research.

**Range of Writing**
10. Write routinely over extended 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, purposes, and audiences.
COMMON CORE STATE ANCHOR STANDARDS FOR SPEAKING AND LISTENING (K-12):

Comprehension and Collaboration
1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.

Presentation of Knowledge and Ideas
4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and ensure that the organization, development, and style are appropriate to task, purpose, and audience.
5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
6. Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

CA STANDARDS FOR CAREER READY PRACTICE

1. **Apply appropriate technical skills and academic knowledge.**
   Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make connections between abstract concepts with real-world applications and recognize the value of academic preparation for solving problems, communicating with others, calculating measures, and other work-related practices.

2. **Communicate clearly, effectively, and with reason.**
   Career-ready individuals communicate thoughts, ideas, and action plans with clarity, using written, verbal, electronic, and/or visual methods. They are skilled at interacting with others, are active listeners who speak clearly and with purpose, and are comfortable with the terminology common to the workplace environment. Career-ready individuals consider the audience for their communication and prepare accordingly to ensure the desired outcome.

3. **Develop an education and career plan aligned with personal goals.**
   Career-ready individuals take personal ownership of their own educational and career goals and manage their individual plan to attain these goals. They recognize the value of each step in the educational and experiential process and understand that nearly all career paths require ongoing education and experience to adapt to practices, procedures, and expectations of an ever-changing work environment. They seek counselors, mentors, and other experts to assist in the planning and execution of education and career plans.

4. **Apply technology to enhance productivity.**
   Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring and using new technology. They understand the inherent risks—personal and organizational—of technology applications, and they take actions to prevent or mitigate these risks.

5. **Utilize critical thinking to make sense of problems and persevere in solving them.**
   Career-ready individuals recognize problems in the workplace, understand the nature of the problems, and devise effective plans to solve the problems. They thoughtfully investigate the root cause of a problem prior to introducing solutions. They carefully consider options to solve the problem and, once agreed upon, follow through to ensure the problem is resolved.

6. **Practice personal health and understand financial literacy.**
   Career-ready individuals understand the relationship between personal health and workplace performance. They contribute to their personal well-being through a healthy diet, regular exercise, and...
mental health activities. Career-ready individuals also understand that financial literacy leads to a secure future that enables career success.

7. **Act as a responsible citizen in the workplace and the community.**
   Career-ready individuals understand the obligations and responsibilities of being a member of a community and demonstrate this understanding every day through their interactions with others. They are aware of the impacts of their decisions on others and the environment around them and think about the short-term and long-term consequences of their actions. They are reliable and consistent in going beyond minimum expectations and in participating in activities that serve the greater good.

8. **Model integrity, ethical leadership, and effective management.**
   Career-ready individuals consistently act in ways that align with personal and community-held ideals and principles. They employ ethical behaviors and actions that positively influence others. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the direction and actions of a team or organization, and they recognize the short-term and long-term effects that management’s actions and attitudes can have on productivity, morale, and organizational culture.

9. **Work productively in teams while integrating cultural and global competence.**
   Career-ready individuals positively contribute to every team as both team leaders and team members. They apply an awareness of cultural differences to avoid barriers to productive and positive interaction. They interact effectively and sensitively with all members of the team and find ways to increase the engagement and contribution of other members.

10. **Demonstrate creativity and innovation.**
    Career-ready individuals recommend ideas that solve problems in new and different ways and contribute to the improvement of the organization. They consider unconventional ideas and suggestions by others as solutions to issues, tasks, or problems. They discern which ideas and suggestions may have the greatest value. They seek new methods, practices, and ideas from a variety of sources and apply those ideas to their own workplace practices.

11. **Employ valid and reliable research strategies.**
    Career-ready individuals employ research practices to plan and carry out investigations, create solutions, and keep abreast of the most current findings related to workplace environments and practices. They use a reliable research process to search for new information and confirm the validity of sources when considering the use and adoption of external information or practices.

12. **Understand the environmental, social, and economic impacts of decisions.**
    Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact other people, organizations, the workplace, and the environment. They are aware of and utilize new technologies, understandings, procedures, and materials and adhere to regulations affecting the nature of their work. They are cognizant of impacts on the social condition, environment, workplace, and profitability of the organization.

**CTE KNOWLEDGE AND PERFORMANCE ANCHOR STANDARDS:**

1.0 **Academics:** Students will analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment.

2.0 **Communications:** Students will acquire and accurately use Manufacturing and Product Design sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats.

3.0 **Career Planning and Management:** Students will integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.

4.0 **Technology:** Students will use existing and emerging technology, to investigate, research, and produce products and services, including new information, as required in the Manufacturing and Product Design sector workplace environment.
5.0 Problem Solving and Critical Thinking: Students will conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the Manufacturing and Product Design sector using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques.

6.0 Health and Safety: Students 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 Design sector workplace environment.

7.0 Responsibility and Flexibility: Students will initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the Manufacturing and Product Design sector workplace environment and community settings.

8.0 Ethics and Legal responsibilities: Students will practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms.

9.0 Leadership and Teamwork: Students will work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution as practiced in the SkillsUSA career technical student organizations.

10.0 Technical Knowledge and Skills: Students will apply essential technical knowledge and skills common to all pathways in the Manufacturing and Product Design sector, following procedures when carrying out experiments or performing technical tasks.

11.0 Demonstration and Application: Students demonstrate and apply the knowledge and skills contained in the Manufacturing and Product Design anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings.

DETAILED UNITS OF INSTRUCTION:

Unit 1: Safety
Students will learn about shop hazards and safety procedures. Students will learn correct procedures to work in the shop safely and efficiently. Students will need to demonstrate safe and proven methods of shop procedures through participating in a demonstration of shop procedures. Students will also be able to list the five most hazardous conditions for each machine tool.

Unit 2: Layout and Measurement
Students will learn how to layout parts using a surface plate, height gage, divider, layout dye, and prick punch. Students also learn measurement and inspection using a micrometer, calipers, telescoping depth gage, gage blocks, bore gage, thread gage, and sine plate. Student will be able to demonstrate the ability to use layout instruments and complete layout work by completing assigned projects. Students will learn precision part measurement and layout and be able to list the purpose and technique for using different measurement instruments.

Unit 3: Project Innovation Preparation and Planning
Students will identify common drawing tools, define and explain drawing symbols and their uses, and explain the difference between pictorial and three-view drawings and read and interpret a drawing. Students will create a digital project drawing, define terms associated with a bill of materials, explain the components of a bill of materials, and prepare a written bill of materials. Select and plan for an advanced level manufacturing project. Create or modify project plans.

Unit 4: Product Innovation Implementation
Complete an advanced manufacturing project to include design, pattern creation, material selection, modeling, layout, tool selection, cutting, assembly, and finishing.

Unit 5: Career Exploration
Students will list two to five careers for each area within the manufacturing field and identify the necessary skill sets. Students will develop a detailed educational plan to prepare for a career in manufacturing. Students will
shadow a manufacturing professional in the field and prepare a written report about the experience. Students will create a portfolio showcasing skills learned throughout the course, and a cover letter and resume applicable to a career in the field of manufacturing.

**TEXTBOOKS AND RESOURCE MATERIALS:**

**Textbooks**
*Mastercam Software Handbook*
*Precision Machining Technology*; Hoffman, et al; 2012
*Operations Manual for Machine Tool Technology*; Oliver: 1982
*No student textbook is required*

**Resource Materials**
Teacher recommended resource materials

**CTE PATHWAY STANDARDS TO BE ADDRESSED:**

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.
D1.1 Identify the variations in the product design and development process as it relates to the designing of a product, product line, system design, or service.
D1.2 Apply and identify the various phases of the product design development process to an existing product, product line, system design, or service.

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.
D2.2 Organize information to identify and define an area of opportunity, need, or problem that can be resolved through design.
D2.3 Identify potential design areas (e.g., product, product line, system design, or service) that would address the need, problem, or opportunity.
D2.4 Research and identify the user demographic for the product, product line, system design, or service (local, national, global market).

D3.0 Understand and apply various ideation techniques to develop ideas and concepts.
D3.1 Apply ideation techniques to explore and produce multiple concepts.
D3.2 Edit concepts and identify key idea(s) that solve the problem, fulfill a need, or address an opportunity.
D3.3 Assess the environmental impact of the design solution and other sustainability issues and product life cycle considerations.
D3.4 Synthesize information and experiment with nontraditional possibilities for innovative design solutions.

D4.0 Apply various two-dimensional (2-D) graphic and/or three-dimensional (3-D) modeling techniques to development concept.
D4.1 Create a preliminary design of a product concept utilizing drawing, computer software (graphic or CAD), and/or conceptual model fabrication techniques.
D4.2 Identify materials, mechanisms, technologies, and other requirements (e.g., safety, manufacturing, sustainability) the concept may require.
D4.3 Analyze and assess the strengths and weaknesses in the design, function, ergonomics, features, and benefits and identify possible resolutions for improvement.

D5.0 Develop the concept into a well-defined product for prototyping.
D5.1 Produce technical drawings and other specifications required for the prototyping or manufacturing of the product.
D5.2 Recognize the safety issues related to the reliability, functionality, and use of the product.
D5.3 Communicate and collaborate with fabricators, manufacturers, engineers, technologists, or other industry experts to review requirements and specifications and to validate the design.

D6.0 Produce a prototype of a product.
D6.1 Build a looks-like, works-like prototype of the model using the appropriate fabrication, manufacturing, or reproduction techniques or technologies.
D6.2 Assess the outcome of the prototype product and analyze any issues that need redesigning or refining related to function, construction, or other factors.
D6.3 Resolve and/or redesign issues with a prototype.

D7.0 Evaluate the prototype to determine if it meets the requirements and objectives.
D7.1 Create a performance criteria and a quality standard to measure and evaluate a prototype.
D7.2 Test the functionality and other features of the prototype against the performance criteria and quality standard and evaluate the results.
D7.3 Identify any redesigning or additional corrections required to improve the overall quality, look, and performance of the prototype model.

D8.0 Understand and apply basic business and entrepreneurial principles and identify potential markets and/or other business opportunities for distribution of the product.
D8.2 Create a marketing plan for the product that includes target consumer, price, product name, brand, and product positioning in the retail market.

D10.0 Produce a presentation of the product, product line, system design, or service.
D10.1 Create a presentation of the design solution (e.g., product, product line, system design, or service) that effectively communicates its features and benefits.
D10.2 Integrate into the presentation a marketing plan that may include an advertisement, promotion, and packaging/retail strategy using one or more visual communication tools (e.g., graphics, multimedia).

DISTRICT ESLRS TO BE ADDRESSED:

Students will be:

- **Self-Directed Learners:** Students will utilize their knowledge of design and manufacturing to effectively complete learning goals and objectives. This will require students to apply multiple attempts to test and verify concepts through application.

- **Constructive Thinkers:** Design and product development will need to be accomplished with a group setting where communication and group accountability will be critical for success. Students will also learn how to effectively apply learned curriculum to real world applications; how best to research and request information, interpret, and display information correctly.

- **Effective Communicators:** Students will be expected to design original products, and students will provide information on designing and developing creative and efficient ways to develop products.

- **Collaborative Workers:** Using curriculum fundamentals of designing and manufacturing, students will collaboratively work in groups to design and develop original products; as a team they will need to develop their own unique product. They will establish group responsibilities and processes to function effectively and develop within a timely manner.

- **Quality Producers/Performers:** Students will use knowledge from the course to safely and appropriately design and develop original products.

- **Responsible Citizens:** Students will develop and practice processes to develop products within their groups.