

FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT



Engineering Technology

Board Approval Date: December 14, 2023	Course Length: 2 Semesters
Grading: A-F	Credits: 5 Credits per Semester
Proposed Grade Level(s): 9, 10, 11	Subject Area: Elective Elective Area (if applicable): Career Technical Education
Prerequisite(s): None	Corequisite(s):
CTE Sector/Pathway: Engineering and Architecture / Engineering Technology	
Intent to Pursue 'A-G' College Prep Status: Yes	
A-G Course Identifier: (g) College-preparatory elective	
Graduation Requirement: No	
Course Intent: District Course Program (if applicable): CTE	
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COURSE DESCRIPTION:

Engineering Technology is a concentrator level course in which students develop problem-solving skills, with emphasis placed on three-dimensional solid models. The course is one year in length and primarily offered to 9th to 11th grade students. Students will work from sketching simple geometric shapes to applying a solid modeling computer software package. They will learn a problem-solving design process and how it is used in industry to manufacture a product. The Computer Aided Design System (CAD) will also be used to analyze and evaluate the product design.

The techniques learned and industry specific equipment used is the foundation for the sequence of courses in Engineering Technology CTE Pathway. Age-appropriate activities are designed for students and will be an integral part of the course. All students will benefit from this course regardless of their respective learning styles, learning rates, or gender.

DETAILED UNITS OF INSTRUCTION:

Unit Number/Title	Unit Essential Questions	Examples of Formative Assessments	Examples of Summative Assessment
1. Introduction to Engineering	What is the Engineering Design Process? What are career options within the field of engineering and what roles do those professions play in the creation of our modern built environment?	*Explain the Process: Using a common product, explain each step of the design process and how it was used in the final product creation	*Task: For this project, students should be divided into teams and given a real-world problem or challenge to solve. This challenge could be related to a simple product design or a broader engineering problem. Students will follow the engineering design process to develop a solution. *Assessment Criteria: Assess each team's ability to apply the engineering design process, including problem identification, research, brainstorming, concept development, prototyping, testing, and documentation. Evaluate the quality and effectiveness of their final design solutions and their ability to communicate their design process and rationale.

			This assessment not only tests their understanding of the engineering design process but also their teamwork and problem-solving skills.
2. Hand Drafting	How does hand drafting contribute to the development and communication of engineering designs, and what are its advantages and limitations compared to digital methods? What are the fundamental principles and techniques of hand drafting, and how can they be applied to create accurate and detailed technical drawings?	*Sketch Review: Ask students to sketch a simple engineering object by hand, such as a mechanical gear. Provide feedback on the accuracy of their hand-drawn technical details, line weights, and annotations, and guide them on improving their drafting skills. *Error Identification: Present students with a partially completed hand-drawn engineering diagram with intentional errors. Ask them to identify and correct the errors, explaining their corrections and the drafting principles they applied.	*Task: Ask students to design and create detailed hand-drawn woodworking plans for a small piece of furniture or a decorative item of their choice. The plans should include orthographic projections, dimensions, material specifications, and assembly instructions. *Assessment Criteria: Evaluate the completeness and accuracy of the hand-drawn plans, including the quality of drafting, clarity of instructions, and adherence to woodworking standards.
3. CAD Modeling	How does computer-aided design (CAD) modeling revolutionize the product design process, and what are the key skills and tools needed to effectively create 3D models for engineering applications? How can CAD modeling be used to simulate and analyze the performance, functionality, and aesthetics of a product design before physical prototypes are built, and how does this improve the design process?	*3D Model Evaluation: Assign a project where students create a 3D CAD model of a common object. Have them evaluate each other's models, identifying areas of improvement, accuracy, and efficient use of CAD tools. *Design Modification Challenge: Present students with a 3D CAD model and ask them to make specific modifications while adhering to design constraints. Assess their ability to navigate the CAD software and modify the model as instructed.	*Task: Have students design and model a complex 3D object using CAD software. The project should include proper modeling techniques, assembly, and realistic rendering. They can choose to design anything from a machine part to a consumer product. *Assessment Criteria: Assess the quality of the 3D model, its accuracy, level of detail, assembly, and the realism of the rendered images. Students should also provide a design

			rationale.
4. Engineering Math	What are the essential mathematical concepts and equations that underpin various engineering disciplines, and how are they applied to solve real-world engineering problems? How can mathematical modeling and analysis be used to optimize designs, make informed decisions, and ensure the safety and efficiency of engineering systems?	*Math Problem Solving: Provide students with engineering math problems related to their current coursework. Have them solve these problems and submit their solutions for feedback and discussion. *Math Concept Application: Present students with real-world engineering scenarios and ask them to identify which mathematical concepts and equations are relevant, explaining how they would apply them to solve the given problem.	*Task: Assign a project where students must optimize a design based on specific engineering criteria. They may choose a 3D CAD model for CAD projects or a woodworking project for the woodshop. The optimization can focus on material use, cost reduction, structural integrity, or other relevant parameters. *Assessment Criteria: Evaluate the student's ability to apply mathematical concepts to optimize the design, document the changes made, and explain the rationale behind their decisions.
5. Form and Function	How do form and function intersect in product design, and how can engineers balance aesthetics and usability to create successful and user-friendly products? What are the key principles and methodologies for ensuring that the form of a product is aligned with its intended function, and how does this impact user experience and overall product performance?	*Product Analysis Presentation: Have students select a product and present an analysis of how the form and function are interrelated. They should discuss the design choices made and how they impact user experience. *Design Critique and Redesign: Ask students to find a product with design flaws. Have them critique the flaws in terms of form and function and then propose a redesign that addresses these issues while maintaining the product's core functionality.	*Task: Challenge students to design a product that serves a specific function, such as a mechanical assembly or a piece of furniture. Emphasize the balance between form and function, ensuring that the final product is both functional and aesthetically pleasing. *Assessment Criteria: Evaluate the design's functionality, form, and how well the students integrated both aspects. Include criteria for ergonomics, aesthetics, and how well the product serves its intended purpose.

6. Tools of the Trade	What are the essential tools and equipment used in various engineering fields, and how do engineers select and utilize them effectively in the design and manufacturing process? How has the integration of digital tools, software, and technology transformed the engineering industry, and what are the advantages and challenges associated with this evolution? What is the appropriate tool to accomplish construction/testing of this product?	*Tool Demonstration: Assign a tool or software demonstration task. Students should choose a specific engineering tool or software and create a step-by-step video tutorial showing how to use it effectively. *Digital Tool Comparison: Provide a list of CAD software options and ask students to research and compare them in terms of features, cost, and suitability for different engineering applications.	*Task: Ask students to select a specific tool or software and create a project that demonstrates its use. In the case of CAD, this could involve creating a tutorial on using a particular CAD tool or feature. In woodshop, they could demonstrate a woodworking technique using a specific tool. *Assessment Criteria: Assess the clarity and effectiveness of the demonstration or tutorial, as well as the student's understanding of the tool or software and its application.
7. Engineering Documentation	How does comprehensive and accurate engineering documentation impact the product development and manufacturing processes, and what are the best practices for creating and managing engineering documents? What are the different types of engineering documents, such as drawings, specifications, and technical reports, and how do they facilitate communication and collaboration within a design team and with external stakeholders?	*Technical Drawing Exercise: Assign a technical drawing task where students need to create a detailed technical drawing of a simple object. Evaluate their drawings for completeness, accuracy, and adherence to industry standards. *Documentation Review: Present students with a set of engineering documents, including drawings, specifications, and reports. Ask them to review these documents and provide feedback on clarity, consistency, and completeness.	*Task: Assign a project where students must create a comprehensive documentation package for their CAD design or woodworking project. This should include technical drawings, specifications, assembly instructions, and a bill of materials. *Assessment Criteria: Evaluate the completeness and accuracy of the documentation package, ensuring that it meets industry standards and is clear and organized.
8. Product Life Cycle and Ethical Design	How does a thorough understanding of the product life cycle contribute to sustainable design and engineering practices, and how can engineers make ethical	*Product Life Cycle Analysis: Assign a project where students choose a product and create a visual representation of its entire life cycle, highlighting environmental and ethical considerations at	*Task: Challenge students to design a product while considering its entire life cycle, from raw materials to disposal. They should also conduct a

	decisions throughout a product's lifecycle? What ethical considerations and responsibilities do engineers have in terms of product design, manufacturing, usage, and disposal, and how can these be integrated into the design process to minimize environmental and societal impact?	each stage. *Ethical Design Dilemma: Present students with a complex ethical dilemma related to a product's design, use, or disposal. Ask them to analyze the situation, propose ethical solutions, and defend their choices.	sustainability analysis, considering environmental and ethical factors. *Assessment Criteria: Evaluate the quality of the design, the depth of the life cycle analysis, and the ethical considerations integrated into the project. Students should present their findings and design decisions.
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ESSENTIAL STANDARDS:

B1.0 Communicate and interpret information clearly in industry-standard visual and written formats.

B1.1 Explain the classification and use of various components, symbols, abbreviations, and media common to technical drawings.

B1.2 Describe the current industry standards for illustration and layout.

B1.3 Draw flat layouts of a variety of objects by using the correct drafting tools, techniques, and media.

B1.4 Organize and complete an assembly drawing using information collected from detailed drawings.

B1.5 Create reports and data sheets for writing specifications.

B2.0 Demonstrate the sketching process used in concept development.

B2.1 Understand the process of producing proportional two- and three-dimensional sketches and designs.

B2.2 Apply sketching techniques to a variety of architectural and engineering models.

B2.3 Present conceptual ideas, analysis, and design concepts using freehand graphic communication techniques.

B3.0 Identify the fundamentals of the theory, measurement, control, and applications of electrical energy, including alternating and direct currents.

B3.1 Understand the characteristics of alternating current (AC) and how it is generated; the characteristics of the sine wave; and of AC, tuned, and resonant circuits; and the nature of the frequency spectrum.

B3.2 Analyze relationships between voltage, current, resistance, and power related to direct current (DC) circuits.

B3.3 Calculate, construct, measure, and interpret both AC and DC circuits.

B3.4 Understand how electrical control and protection devices are used in electrical systems.

B3.5 Calculate loads, currents, and circuit-operating parameters.

B3.6 Classify and use various electrical components, symbols, abbreviations, media, and standards of electrical drawings.

B3.7 Analyze, repair, or measure electrical and electronic systems, circuits, or components using appropriate electronic instruments.

B3.8 Predict the effects of circuit conditions on the basis of measurements and calculations of voltage, current, resistance, and power.

B4.0 Understand the concepts of physics that are fundamental to engineering technology.

B4.1 Describe Newton's laws and how they affect and define the movement of objects.

B4.2 Explain how the laws of conservation of energy and momentum provide a way to predict and describe the movement of objects.

B4.3 Compare the effects and applications of heat transfer and thermal dynamic processes.

B4.4 Explore the fundamentals and properties of waveforms and how waveforms may be used to carry energy.

B4.5 Analyze how electric and magnetic phenomena are related and know common practical applications.

B5.0 Understand how the principles of force, work, rate, power, energy, and resistance relate to mechanical, electrical, fluid, and thermal engineering systems.

B5.1 Differentiate between scalars and vectors.

B5.2 Solve problems by using the concept of vectoring to predict resultants.

B5.3 Compare and explore the six simple machines and their applications.

B5.4 Evaluate how energy is transferred and predict the effects of resistance in mechanical, electrical, fluid, and thermal systems.

B5.5 Formulate and solve problems by using the appropriate units applied in mechanical, electrical, fluid, and thermal engineering systems.

B6.0 Employ the design process to solve analysis and design problems.

B6.1 Understand the steps in the design process.

B6.2 Determine what information and principles are relevant to a problem and its analysis.

B6.3 Choose between alternate solutions in solving a problem and be able to justify the choices made in determining a solution.

B6.4 Translate word problems into mathematical statements when appropriate.

B6.5 Demonstrate the process of developing multiple details, within design constraints, into a single solution.

B6.6 Construct a prototype from plans and test it.

B6.7 Evaluate and redesign a prototype on the basis of collected test data.

B7.0 Understand industrial engineering processes, including the use of tools and equipment, methods of measurement, and quality assurance.

B7.1 Know the structure and processes of a quality assurance cycle.

B7.2 Describe the major manufacturing processes.

B7.3 Use tools, fasteners, and joining systems employed in selected engineering processes.

B7.4 Estimate and measure the size of objects in both Standard International and United States units.

B7.5 Apply appropriate geometric dimensioning and tolerancing (GD&T) practices.

B7.6 Calibrate precision measurement tools and instruments to measure objects.

B8.0 Understand fundamental control system design and develop systems that complete preprogrammed tasks.

B8.1 Identify the elements and processes necessary to develop a controlled system that performs a task.

B8.2 Demonstrate the use of sensors for data collection and process correction in controlled systems.

B8.3 Perform tests, collect data, analyze relationships, and display data in a simulated or modeled system using appropriate tools and technology.

B8.4 Program a computing device to control systems or processes.

B8.5 Use motors, solenoids, and similar devices as output mechanisms in controlled systems.

B8.6 Assemble input, processing, and output devices to create controlled systems capable of accurately completing a preprogrammed task.

B9.0 Understand the fundamentals of systems and market influences on products as they are developed and released to production.

B9.1 Understand the process of product development.

B9.2 Understand decision matrices and the use of graphic tools in illustrating the development of a product and the processes involved.

B10.0 Design and construct a culminating project effectively using engineering technology.

B10.1 Use methods and techniques for employing all engineering technology equipment appropriately.

B10.2 Apply conventional engineering technology processes and procedures accurately, appropriately, and safely.

B10.3 Apply the concepts of engineering technology to the tools, equipment, projects, and procedures of the Engineering Technology Pathway.

- B11.0 Understand the methods of creating both written and digital portfolios.
 B11.1 Develop a binder or digital portfolio representative of student work for presentation.
 B11.2 Give an effective oral presentation of a portfolio.

RELEVANT STANDARDS AND FRAMEWORKS, CONTENT/PROGRAM SPECIFIC STANDARDS:

Link to Common Core Standards (if applicable):

Educational standards describe what students should know and be able to do in each subject in each grade. In California, the State Board of Education decides on the standards for all students, from kindergarten through high school.

[CCSS for ELA - Content Standards \(CA Dept of Education\)](#),

Link to Framework (if applicable):

Curriculum frameworks provide guidance for implementing the content standards adopted by the State Board of Education (SBE). Frameworks are developed by the Instructional Quality Commission, formerly known as the Curriculum Development and Supplemental Materials Commission, which also reviews and recommends textbooks and other instructional materials to be adopted by the SBE.

Link to Subject Area Content Standards (if applicable):

Content standards were designed to encourage the highest achievement of every student, by defining the knowledge, concepts, and skills that students should acquire at each grade level.

[Standards for Career Ready Practice Flyer - Standards and Framework \(CA Dept of Education\)](#)

[CTE Model Current Standards: Engineering and Arch - Standards and Framework \(CA Dept of Education\)](#)

Link to Program Content Area Standards (if applicable):

Program Content Area Standards apply to programs such as International Baccalaureate, Advanced Placement, Career and Technical Education, etc.

[CTE Model Current Standards: Engineering and Arch - Standards and Framework \(CA Dept of Education\)](#)

TEXTBOOKS AND RESOURCE MATERIALS:

Textbooks

Board Approved	Pilot Completion Date (If applicable)	Textbook Title	Author(s)	Publisher	Edition	Date
		N/A				

Other Resource Materials

California Career Zone (online), California Career Resource Network (CDE), SkillsUSA Career Essentials Job Hunting Handbook, Dahlstrom & Company, Inc, Instructor created materials, various online source materials

Supplemental Materials

Board approved supplemental materials (Including but not limited to: Film Clips, Digital Resources, Supplemental texts, DVDs, Programs (Pebble Creek, DBQ, etc.):

N/A