Chino Valley Unified School District
Course Description

CONTACTS	
1. School District Information:	**School:** Chino Valley Unified School District **Street Address:** 5130 Riverside Dr., Chino, CA 91710 **Phone:** (909) 628-1201 **Web Site:** chino.k12.ca.us
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A. COVER PAGE - COURSE ID	
1. Course Title:	Engineering Design and Development (PLTW)
2. Transcript Title/Abbreviation:	EDD
3. Transcript Course Code/Number:	5P03
4. Seeking Honors Distinction:	Yes
5. Subject Area/Category:	g (elective)
6. Grade level(s):	12
7. Unit Value:	5 units per semester/10 credits - elective
8. Was this course previously approved by UC?	Yes
9. Is this course classified as a Career Technical Education course:	Yes
10. Is this course modeled after an UC-approved course?	Yes
11. Repeatable:	No
12. Date of Board Approval:	July 17, 2014

13. Brief Course Description:
The knowledge and skills students acquire throughout Project Lead the Way (PLTW) Engineering come together in Engineering Design and Development (EDD) as they identify an issue and then research, design, and test a solution, ultimately presenting their solution to a panel of engineers. Students apply the professional skills they have developed to document a design process to standards, completing EDD ready to take on any post-secondary program or career.

14. Prerequisites:	Must have completed at least one PLTW engineering course.
15. Co-Requisites: (Recommended)	College Preparatory math and science.

16. Context for Course:
Engineering Design and Development is the capstone course in the PLTW high school engineering program. It is an engineering research course in which students work in teams to design and develop an original solution to a valid open-ended technical problem by applying the engineering design process. The course applies and concurrently develops secondary level knowledge and skills in mathematics, science, and technology.

Utilizing the activity-project-problem-based (APPB) teaching and learning pedagogy, students will perform research to choose, validate, and justify a technical problem. After carefully defining the problem, teams of students will design, build, and test their solution. Finally, student teams will present and defend their original solution to an outside panel. While progressing through the engineering design process, students will work closely with a community mentor and experts and will continually hone their organizational, communication and interpersonal skills, their creative and problem solving abilities, and their understanding of the design process.

Engineering Design and Development is a high school level course that is appropriate for 12th grade students. Since the projects on which students work can vary with student interest and the curriculum focuses on problem solving, EDD is appropriate for students who are interested in any technical career path. EDD should be taken as the final capstone PLTW course since it requires application of the knowledge and skills from the PLTW foundation courses.

17. History of Course Development:

This course is part of the nationally acclaimed Project Lead the Way high school engineering curriculum. It was developed with input and feedback from a nationwide network of industry professionals, post-secondary and community partners and educators to serve as a capstone for the PLTW courses.

18. Textbooks:	PLTW's Electronic Classroom Resources including the PLTW electronic textbook for Engineering Design and Development.

B. COURSE CONTENT

Course Purpose:

This course of study includes:

- The Design Process
- Intellectual Property
- Research
- Problem Identification, Validation, and Justification
- Teamwork
- Project Management
- Design Specifications
- Concept Testing
- Design Proposal
- Virtual Solutions
- Building a Prototype
- Testing a Prototype
- Test Evaluation and Refinement
- Documentation
- Presenting the Process and Results to a Panel of Experts

Course Outline:

Component 0 – Project Management
Engineering Design and Development as a Course
(α) Resources – Engineering Design and Development as a Course
(β) Resources – Documenting an Engineering Design Process
(γ) Resources – Teams, Timelines, and Contacting Experts
(δ) Resources – Project Evaluation and Scoring Rubrics
(ε) Resources – Intellectual Property

Component 1 – Researching a Problem
Problem Identification, Justification and Defining Solution Requirements
Element A – Problem Identification and Justification
Element B – Identification and Analysis of Prior Solution Attempts
Element C – Presentation and Justification of Solution Design Requirements

Component 2 – Designing a Solution
Generating and Defending an Original Solution
Element D – Design Concept Generation, Analysis, and Selection

Element E – Application of STEM Principles and Practices
Element F – Consideration of Design Viability

Component 3 – Creating a Prototype and Testing Plan
Creating and Testing a Prototype
Element G – Creation of a Testable Prototype
Element H – Prototype Testing and Data Collection Plan
Element I – Data Results and Testing Analysis

Component 4 – Evaluation and Reflection on the Design Process
Evaluation, Reflection, and Designer Recommendations
Element J – Documentation of External Evaluation
Element K – Designer Reflection on the Process
Element L – Presentation of Designer's Recommendations

Component 5 – Presentation of the Design Process
Final Presentation and Documentation
Element M – Presentation of the Project and Project Portfolio
Element N – Writing Like an Engineer

Component 6 – Going Beyond Engineering Design and Development (EDD)

Course Objectives:
Component 0: Project Management

Understandings Addressed Course Wide:

1. The work of engineers has an impact on our society.
2. An open ended design process involves identifying a justifiable problem and developing an original solution that attempts to solve it.
3. The engineering design process is typically non-linear. Designers may need to re-visit steps in the process or take next steps based on feedback from previous steps.
4. The engineering design process is both a guide and a series of waypoints for effective problem solving. It is a tool for self-evaluation as an engineer moves through the process.
5. There are principles and practices related academic research. Topic selection and design decisions should be research driven and driven data whenever possible.
6. There are principles, practices, and techniques related to technical writing.
7. There are principles and practices related to documenting an engineering design process that allow teams to work effectively, preserve the work allowing continuation at a later date, and protect the designer's intellectual property.
8. Project management is the discipline of planning, organizing, motivating, utilizing resources to achieve specific goals.
9. Relevant principles and practices of Science, Technology, Engineering, and Mathematics (STEM) should be used to inform and justify design choices. They should be evident and well documented in an engineering design process.
10. Individuals and other entities put extraordinary effort into protecting their intellectual property so they can control who has access to and use of their work. Intellectual property protections allow individuals or companies to maintain rights to profit from their ideas.

11. There are many stakeholders involved in an open ended engineering design process.
12. The ability to communicate as a professional is a critical skill for engineers.
13. Measurable design requirements are developed from a problem statement. Design requirements guide engineers through the design process and help determine if the solution is successful at solving the identified problem.
14. Multiple design possibilities should be explored in an engineering design process.
15. Testing is a critical component to any engineering design process. A plan and process for testing the proposed solution both qualitatively and quantitatively against design requirements should be created and carried out.
16. Engineering design projects are typically peer reviewed. Stakeholder feedback and design reviews help guide engineers through the design process.
17. Presentation of this design process and project findings are critical to the engineering design process.

Component 1: Researching a Problem
Problem Identification, Justification and Defining Solution Requirements

Understandings Addressed in Component:

1. Project management is the discipline of planning, organizing, motivating, utilizing resources to achieve specific goals.
2. The work of engineers has an impact on our society.
3. An open ended design process involves identifying a justifiable problem and developing an original solution that attempts to solve it.
4. There are principles and practices related academic research. Topic selection and design decisions should be research driven and driven data whenever possible.
5. There are principles, practices, and techniques related to technical writing.
6. There are principles and practices related to documenting an engineering design process that protect the designer's intellectual property. This ensures that the designer has generated an original solution.
7. A well developed and accurately written problem statement identifies a need and guides an engineering design process.
8. A well developed and accurately written problem statement identifies a need and aims the engineer toward developing measureable and objective design requirements which guide the rest of the design process.
9. Individuals and other entities put extraordinary effort into protecting their intellectual property so they can control who has access to and use of their work. Intellectual property protections allow individuals or companies to maintain rights to profit from their ideas.
10. Experts are professionals that have specific knowledge in an area of interest and can guide the research needed for accurate justification and solutions to design problems.
11. The ability to communicate as a professional is a critical skill for engineers.
12. Effective market research focuses on potential users and buyers to gauge whether a problem is worth the investment required for a solution to be attempted.
13. Effective market research focuses on potential users and buyers to gauge whether a problem is worth the investment required for it to be solved.
14. Research and analysis of past solution attempts can help a designer identify critical design specifications or features in any viable solution designed.
15. Engineering design projects are typically peer reviewed. Stakeholder feedback and design reviews help guide engineers through the design process.
16. Design goals include specifications, constraints, parameters, desired features, and fundamental design considerations.
17. Presentation of a project proposal is a critical way-point in the design process.

Component 2: Designing a Solution
Generating and Defending an Original Solution

Understandings Addressed in Component:

1. Relevant principles and practices of Science, Technology, Engineering, and Mathematics (STEM) should be used to inform and justify design choices. They should be evident and well documented in an engineering design process.
2. Engineers use a peer review process to evaluate design solutions, provide feedback, and implement necessary revisions.
3. Effective design teams typically have a diverse set of viewpoints.
4. Multiple design possibilities should be explored in an engineering design process.
5. Design goals include specifications, constraints, parameters, desired features, and fundamental design considerations.
6. Testing is a critical component to any engineering design process. A prototype should be created that can be tested qualitatively and quantitatively.
7. Assessing a product's lifecycle creates an opportunity for identifying potential improvements in the process and provides a method for evaluating the product's degree of success.
8. A decision matrix is one tool designers can use to compare preliminary design solutions. A solution path can be determined by assessing each alternate design based on the design requirements specified.
9. Drawings and sketches are used to organize, record, and communicate ideas.
10. An effective use of the design process includes the use of a variety of forms of technical visual communication. This may include, but not be limited to technical drawings, circuit diagrams, process or flow charts.
11. Virtual solutions for designs allow engineers to plan, test, and prepare for building a prototype.
12. Engineers and designers have ethical responsibilities to clients, peers, their profession, and the general public.
13. Product development will result in consequences, both good and bad, that must be considered when deciding whether or not to develop a product.
14. There are many stakeholders involved in an open ended engineering design process.
15. The ability to communicate as a professional is a critical skill for engineers.
16. A Preliminary Design Review is a peer review process to determine the viability of the final design proposed and if other modifications can be identified before the prototyping and testing phase.

Component 3 – Creating a Prototype and Testing Plan
Creating and Testing a Prototype

Understandings Addressed in Component:

1. Relevant principles and practices of Science, Technology, Engineering, and Mathematics (STEM) should be used to inform and justify design choices. They should be evident and well documented in an engineering design process.
2. Project management is the discipline of planning, organizing, motivating, utilizing resources to achieve specific goals.
3. During the construction of a prototype, safety in the workplace is a critical component. All safety guidelines and procedures should be followed.
4. Material, tools, and equipment requirements are defined by creating a materials and cost analysis before the construction of a prototype.
5. A prototyping provides the engineer with a scaled working model of the design solution that can be tested.
6. Engineers write step-by-step instructions for the prototype assembly to guide the fabrication of the design

solution.

7. Designers must consider characteristics such as strength and weight of materials and fastening procedures to be sure that the final design meets design specifications.
8. Testing is a critical component to any engineering design process. A plan and process for testing the proposed solution both qualitatively and quantitatively against design requirements should be created and carried out.
9. Prototypes can generally be broken down into subsystems in order to isolate problems and conduct incremental testing.
10. Prototype testing is a controlled procedure that is used to evaluate a specific aspect of a design solution.
11. In order to gather useful data, specific criteria for success or failure of a test must be determined before testing begins.
12. A detailed description of the testing procedure helps to ensure that the results of the design solution testing are valid.
13. Data can be classified as either quantitative because it can be measured or qualitative because it describes a quality or categorization.
14. The results of prototype testing are used to refine the design and to improve the design solution.
15. A Critical Design Review is used to determine the quality and functionality of the final prototype. Designers should seek feedback from key stakeholders to determine if any modifications or improvements can be made before finalizing the testing process.

Component 4 – Evaluation and Reflection on the Design Process
Evaluation, Reflection, and Designer Recommendations

Understandings Addressed in Component:

1. The engineering design process is typically non-linear. Designers may need to re-visit steps in the process or take next steps based on feedback from previous steps.
2. The engineering design process is both a guide and a series of waypoints for effective problem solving. It is a tool for self-evaluation as an engineer moves through the process.
3. There are many stakeholders involved in an open ended engineering design process.
4. The ability to communicate as a professional is a critical skill for engineers.
5. Engineering design projects are typically peer reviewed. Stakeholder feedback and design reviews help guide engineers through the design process.
6. Presentation of this design process and project findings are critical to the engineering design process.

Component 5 – Presentation of the Design Process
Final Presentation and Documentation

Understandings Addressed in Component:

1. Presentation of this design process and project findings are critical to the engineering design process.
2. Presentations and displays of work provide the means to effectively promote and justify the implementation of a project.
3. There are principles and practices related to documenting an engineering design process that protect the designer’s intellectual property. This ensures that the designer has generated an original solution.
4. A well-done presentation can enhance the perception of the quality of work completed for a team project.
5. The use of presentation software allows designers to present visual aids and project information in a professional manner.
6. The media format used for a presentation is chosen in order to effectively communicate the design solution process to a target audience.

Component 6 – Going Beyond EDD

Key Assignments:

- Project Proposal - Student students select a problem, research background information on the topic, justify their selection, research past and present solutions, and then identify the design parameters.
- Build a Testable Prototype - Students sketch, model, document, and build a prototype of their solution.
- Judged Presentation - After testing and modifications, the students perform a critical design review and create a multi-media display for a judged presentation by a panel of experts.
- Notebook/Portfolio - Students maintain an engineering notebook and online portfolio documenting all the work and effort done throughout the course.

Instructional Methods and/or Strategies:

Students will be engaged in a variety of activities that balance direct instruction with project work. Students will be expected to apply the concepts and processes learned during direct instruction to their projects. Students will attend lectures, complete labs, become involved with professional mentors, complete real-world projects, and make presentations that demonstrate understanding of design/fabrication concepts and the research process.

Methods of instruction will include:
1. Direct instruction (lectures, discussions, readings, and lab activities specific for mastery of content);
2. Use of Activity, Problem, Project-Based Learning with support from professional mentors;
3. Development of language arts skills while students complete reports, journals, analyses, and essays;
4. Use of educational courseware, interfaced probe ware, scientific instrumentation, and professional software;
5. Use of a variety of instructional materials and resources including electronic media, handbooks, professional journals, reference materials, and textbooks;
6. Self-directed, cooperative, and collaborative learning opportunities to increase responsibility of students for their own learning;
7. Use of student presentations, exhibits, and competitions;
8. Embedded assessments as a learning tool;
9. Differentiated instruction for exceptional students; and
10.Activities which promote scientific knowledge and adaptation of technology

Assessment Including Methods and/or Tools:

Assessment opportunities that allow continuous evaluation of student progress will be embedded throughout the course and will be a part of the learning experience. All students will be expected to achieve mastery of all topics, often with demonstration of mastery occurring during a public forum. The following strategies, which include both formal and informal assessment techniques, may include but are not limited to:
Written tests with a variety of short answer, essay questions, and problems;
Performance-based assessments such as experiments, demonstrations, discussions, debates, simulations, and projects;
Presentations, both team and individual:
A cumulative portfolio of investigative accomplishments; and written assignments (such as justification, investigations, primary and secondary research, evaluative, or technical)