

CTE/ROP Engineering Research And Development (EDD)

San Diego County Office of Education - Sweetwater Union High School District Pacing Guide/Course Description

Course Length: 1 Year	Classroom Instruction:
SUHSD Course Number: 97324 / 97325	Grade Level: 12 th
SDCOE Course Number:	SDCOE Total Hours:
CBEDS Number/Title:	Year of Implementation: 2012
Course Pre-requisites:	Articulation (school/credits):
CTE Industry Sector: Engineering Research and Development	CTE Pathway(s): Architectural and Structural Engineering, Engineering Design, Engineering Technology
Job Titles: Mechanical Drafter, Industrial Drafter, Mechanical Engineer, Industrial Engineers, Field Engineer, Civil Engineer, Manufacturer	
Credential Information: Preliminary or Clear Full-Time Designated Subjects CTE Teaching Credential in Engineering Design	
Required Textbooks:	
Course Description: In this capstone course, students work in teams to design and develop an original solution to a valid open-ended technical problem by applying the engineering design process. Students perform research to choose, validate, and justify a technical problem. After carefully defining the problem, teams design, build, and test their solutions while working closely with industry professionals who provide mentoring opportunities. Finally, student teams present and defend their original solution to an outside panel. This course is appropriate for 12th grade students.	

CTE/ROP Engineering Research And Development (EDD)

Semester 1

Unit 1: Project Management
Unit 2: Define The Problem
Unit 3: Design a Solution
Unit 4: Prototype The Solution

Semester 2

Unit 5: Test, Evaluate and Refine The Solution
Unit 6: Communicate The Process and Results
Unit 7: Career Development
Unit 8: Job Acquisition Skills

CTE/ROP Engineering Research And Development (EDD)

<u>Semester 1 - Unit 1 – Project Management (hours)</u>			
Competencies	Standards	Suggested Pacing	Resources/Materials
<p>1A - Identifies two patents directly related to each topic and locates many relevant patents</p> <p>1B - Identifies important details about its development and lifecycle.</p> <p>1C - Creates a practice engineering notebook and follows the design process</p> <p>1D - Makes a tentative plan that the team should follow based on the knowledge of the design process</p> <p>1E - Creates Gantt Chart, which assist with project planning as individuals create a timeline that includes important tasks.</p> <p>1F - Understands his own strengths and weaknesses as well as the strengths, weaknesses, and personalities of other team members.</p>	<p><u>Career Technical Education:</u></p> <p>*ED/EDP/</p> <p>C1.1 Know historical and current events that have relevance to engineering design.</p> <p>C1.2 Understand the development of graphic language in relation to engineering design.</p> <p>*ED/PSCT/</p> <p>5.1 Apply appropriate problem-solving strategies and critical thinking skills to work-related issues and tasks.</p> <p>*ED/LT/</p> <p>9.1 Understand the characteristics and benefits of teamwork, leadership, and citizenship in the school, community, and workplace settings.</p> <p>9.3 Understand how to organize and structure work individually and in teams for effective performance and the attainment of goals.</p> <p><u>Core Academic:</u></p> <p>*M/AI/G8-12/</p> <p>5.0 Students solve multistep problems, including word problems, involving linear equations and linear inequalities in one variable and provide justification for each step.</p> <p>*M/GM/G8-12/</p> <p>11.0 Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids.</p>	<p>1A - Invention and Innovation Patents</p> <p>1B - Product Assessment</p> <p>1C - Design Project</p> <p>1D - The Design Process</p> <p>1E - Project Management, The Rule of Thirds, Team Responsibilities</p> <p>1F - Teamwork</p>	<p><u>Teacher and Student Resources:</u></p>

CTE/ROP Engineering Research And Development (EDD)

Semester 1 - Unit 2 – Define The Problem (hours)			
Competencies	Standards	Suggested Pacing	Resources/Materials
<p>2A - Shows that there is consensus among reliable sources that the problem exists.</p> <p>2B - Provides a team formation starting point.</p> <p>C - Writes a problem statement that could have led to the solution for a product that has been evaluated.</p> <p>2D - Begins with those common interests and work toward formulating a problem statement that will define the problem</p> <p>2E - Translates (with the help of the team) the problem statement into a statement of purpose</p> <p>2F - Gathers information for the Problem Proposal. Will document all the research and include, if applicable, contact information and references in the appropriate sections of the engineering notebook. The student will also create a preliminary draft for each section, using the headings to present the required information.</p> <p>2G - Performs direct market research as part of the overall market research effort.</p> <p>2H - Develops a project proposal to “sell” the project idea to potential investors.</p>	<p><u>Career Technical Education:</u> *ED/C/2.2W/WS/G8/ (1.5) Achieve an effective balance between researched information and original ideas.</p> <p>*ED/C/2.2W/WSA/G9-10/ (1.3) Use clear research questions and suitable research methods (e.g., library, electronic media, personal interview) to elicit and present evidence from primary and secondary sources.</p> <p>(1.4) Develop the main ideas within the body of the composition through supporting evidence (e.g., scenarios, commonly held beliefs, hypotheses, definitions).</p> <p>(1.5) Synthesize information from multiple sources and identify complexities and discrepancies in the information and the different perspectives found in each medium (e.g., almanacs, microfiche, news sources, in-depth field studies, speeches, journals, technical documents).</p> <p><u>Core Academic:</u> *M/GM/G8-12/ 8.0 Students know, derive, and solve problems involving the perimeter, circumference, area, volume, lateral area, and surface area of common geometric figures.</p> <p>9.0 Students compute the volumes and surface areas of prisms, pyramids, cylinders, cones, and spheres; and students commit to memory the formulas for prisms, pyramids, and cylinders.</p> <p>10.0 Students compute areas of polygons, including rectangles, scalene triangles, equilateral triangles, rhombi, parallelograms, and trapezoids.</p>	<p>2A Choosing a Topic.</p> <p>2B Forming Teams</p> <p>2C What Is the Problem?</p> <p>2D Choosing a Problem</p> <p>2E Problem Statement to Statement of Purpose</p> <p>2F Knowledge of the Marketplace</p> <p>2G Conducting Market Research</p> <p>2H Project Proposal</p>	<p><u>Teacher and Student Resources:</u> *Supplemental Instructional Materials: -Technical Drawing by Giesecke, Mitchell, Spencer, Hill, Dygdon, & Novak, Prentice Hall, latest edition -Technology; Design and Applications by R. Thomas Wright, Rayan A. Brown, The Goodheart-Willcox Publisher, latest edition -Manufacturing & Automation Technology by R Thomas Wright, The Goodheart-Willcox Publisher, latest edition -Physics, Principles with Applications by Douglas C. Giancoli, , Prentice Hall, latest edition -AutoCAD, Solid Works, COSMOS Works, Solid Works Animator, latest software editions</p>

CTE/ROP Engineering Research And Development (EDD)

<u>Semester 1 - Unit 3 – Design A Solution (hours)</u>			
Competencies	Standards	Suggested Pacing	Resources/Materials
<p>3A - Creates a design specification for your product.</p> <p>3B - Selects several promising ideas that resulted from brainstorming efforts then further develop each of the selected ideas and document each product concept.</p> <p>3C - Selects the best design solution to pursue from the multiple concepts that have been generated with the use of a decision matrix.</p> <p>3D - Creates a poster (or board) to present conceptual solutions to potential consumers, stakeholders and field experts.</p> <p>3E - Will formalize the past market research and conduct additional research specific to the proposed final design in order to begin creating a business plan.</p> <p>3F - Prepares a written proposal and make a short oral presentation to present the proposed design and justify further development of the product.</p>	<p><u>Career Technical Education:</u> *ED/PSCT/ 5.3 Use critical thinking skills to make informed decisions and solve problems. *ED/EDP/ C2.3 Apply the concepts of engineering design to the tools, equipment, projects, and procedures of the Engineering Design Pathway. C6.2 Apply dimensioning to various objects and features. C8.1 Understand what constitutes mating parts in engineering design. C8.2 Use tolerancing in an engineering drawing. C10.1 Understand the process of producing proportional two- and three-dimensional sketches and designs. C10.3 Use freehand graphic communication skills to represent conceptual ideas, analysis, and design concepts. *ED/C/2.2W/WSA/G11-12/ (1.6) Develop presentations by using clear research questions and creative and critical research strategies (e.g., field studies, oral histories, interviews, experiments, electronic sources). *ED/C/2.4LS/LSSA/G9-10/ (2.2) Deliver expository presentations: a. Marshal evidence in support of a thesis and related claims, including information on all relevant perspectives. b. Convey information and ideas from primary and secondary sources accurately and coherently. c. Make distinctions between the relative value and significance of specific data, facts,</p>	<p>3A Design Specification 3B Concept Development 3C Best Solution 3D Concept Testing 3E Beginning the Business Plan 3F Design Proposal</p>	<p><u>Teacher and Student Resources:</u> <i>*Supplemental Instructional Materials:</i> -Technical Drawing by Giesecke, Mitchell, Spencer, Hill, Dygdon, & Novak, Prentice Hall, latest edition -Technology; Design and Applications by R. Thomas Wright, Rayan A. Brown, The Goodheart-Willcox Publisher, latest edition -Manufacturing & Automation Technology by R Thomas Wright, The Goodheart-Willcox Publisher, latest edition -Autodesk Inventor Professional, Solid Works, COSMOS Works, Solid Works Animator, latest software editions</p>

CTE/ROP Engineering Research And Development (EDD)

	<p>and ideas.</p> <p>d. Include visual aids by employing appropriate technology to organize and display information on charts, maps, and graphs.</p> <p>e. Anticipate and address the listener's potential misunderstandings, biases, and expectations.</p> <p>f. Use technical terms and notations accurately.</p> <p><u>Core Academic:</u> *M/AI/G8-12/</p> <p>15.0 Students apply algebraic techniques to solve rate problems, work problems, and percent mixture problems.</p> <p>16.0 Students understand the concepts of a relation and a function, determine whether a given relation defines a function, and give pertinent information about given relations and functions.</p> <p>17.0 Students determine the domain of independent variables and the range of dependent variables defined by a graph, a set of ordered pairs, or a symbolic expression.</p>		
--	--	--	--

CTE/ROP Engineering Research And Development (EDD)

<u>Semester 1 - Unit 4 – Prototype The Solution (hours)</u>			
Competencies	Standards	Suggested Pacing	Resources/Materials
<p>4A - List all parts and subsystems in his engineering notebook.</p> <p>4B - Creates technical drawings that are necessary to explain the team's design solution. It will generate the technical drawings using 3D modeling software.</p> <p>4C - Creates a document to delineate the resources needed to construct a prototype.</p> <p>4D - Communicates over the phone, in person, via email, and sometimes via mailed letter.</p> <p>4E - Will use sketches and virtual solutions documentation to create a mock-up that will help demonstrate the vision of the final product's appearance.</p> <p>4F - Identifies subsystems in the design and determine how each must perform to be considered successful. It must determine the extent to which each subsystem or element should be tested.</p> <p>4G - Writes a description of how to build the prototype. It should already have most of the necessary information. It will need to compile the information and create the</p>	<p><u>Career Technical Education:</u> *ED/EDP/ C1.2 Understand the development of graphic language in relation to engineering design. C4.1 Understand the commands and concepts necessary for producing drawings through traditional or computer-aided means. C5.4 Apply two-dimensional and three-dimensional CADD operations in creating working and pictorial drawings, notes, and notations. C9.2 Develop drawings using notes and specifications. *ED/ETP/ D5.6 Build a prototype from plans and test it. D5.7 Evaluate and redesign a prototype on the basis of collected test data. D7.1 Understand Newton's laws and how they affect and define the movement of objects. D7.2 Understand how the laws of conservation of energy and momentum provide a way to predict and describe the movement of objects. <u>Core Academic:</u> *M/PRS/G8-12/ 1.0 Students know the definition of the notion of independent events and can use the rules for addition, multiplication, and complementation to solve for probabilities of particular events in finite sample spaces. 2.0 Students know the definition of conditional probability and use it to solve for probabilities in finite sample spaces.</p>	<p>4A Choosing Materials and Fastening Procedures. 4B Virtual Solutions 4C Resource Planning 4D Professional Correspondence 4E Mock-Up (Optional) 4F Identifying Subsystems and Incremental Testing Opportunities (Optional) 4G Build Procedure 4H Build the Prototype</p>	<p><u>Teacher and Student Resources:</u> *Supplemental Instructional Materials: -Technical Drawing by Giesecke, Mitchell, Spencer, Hill, Dygdon, & Novak, Prentice Hall, latest edition -Technology; Design and Applications by R. Thomas Wright, Rayan A. Brown, The Goodheart-Willcox Publisher, latest edition -Manufacturing & Automation Technology by R Thomas Wright, The Goodheart-Willcox Publisher, latest edition -Autodesk Inventor Professional, Solid Works, COSMOS Works, Solid Works Animator, latest software editions</p>

CTE/ROP Engineering Research And Development (EDD)

<p>assembly procedure directions. 4H - Follows the assembly instructions that created during the previous lesson.</p>			
--	--	--	--

CTE/ROP Engineering Research And Development (EDD)

Semester 2 – Unit 5 Test, Evaluate And Refine The Solution – (hours)			
Competencies	Standards	Suggested Pacing	Resources/Materials
<p>5A - Determines the quantitative and qualitative testing criteria for design solution.</p> <p>5B - Specifies a testing method that you will use to objectively measure the effectiveness of solution and/or the parts of your solution based on the test criteria.</p> <p>5C - Test the prototype, collect data, and evaluate the results.</p> <p>5D - Will have an agenda to follow for the review</p> <p>5E - Documents a suitable and substantial plan for modifying the product design only if it's necessary based on the final testing and critical design review.</p>	<p><u>Career Technical Education:</u> *ED/TKS/ 10.6 Understand and apply the appropriate use of quality control systems and procedures. *ED/ETP/ D5.1 Understand the steps in the design process. D5.2 Determine what information and principles are relevant to a problem and its analysis. D10.1 Understand the process of product development. D10.2 Understand charting and the use of graphic tools in illustrating the development of a product and the processes involved.</p> <p><u>Core Academic:</u> *M/AI/G8-12/ 15.0 Students apply algebraic techniques to solve rate problems, work problems, and percent mixture problems. 24.1 Students explain the difference between inductive and deductive reasoning and identify and provide examples of each. 24.2 Students identify the hypothesis and conclusion in logical deduction. 24.3 Students use counterexamples to show that an assertion is false and recognize that a single counterexample is sufficient to refute an assertion. 25.1 Students use properties of numbers to construct simple, valid arguments (direct and indirect) for, or formulate counterexamples to, claimed assertions.</p>	<p>5A Test Criteria 5B Test Procedure 5C Test and Evaluate the Prototype 5D Critical Design Review 5E Redesign and Refine</p>	<p><u>Teacher and Student Resources:</u> *Supplemental Instructional Materials: -Technical Drawing by Giesecke, Mitchell, Spencer, Hill, Dygdon, & Novak, Prentice Hall, latest edition -Technology; Design and Applications by R. Thomas Wright, Rayan A. Brown, The Goodheart-Willcox Publisher, latest edition -Manufacturing & Automation Technology by R Thomas Wright, The Goodheart-Willcox Publisher, latest edition -Physics, Principles with Applications by Douglas C. Giancoli, , Prentice Hall, latest edition -AutoCAD, Solid Works, COSMOS Works, Solid Works Animator, latest software editions</p>

CTE/ROP Engineering Research And Development (EDD)

<u>Semester 2 - Unit 6 – Communicate The Process and Results (hours)</u>			
Competencies	Standards	Suggested Pacing	Resources/Materials
<p>6A - Have all materials necessary to complete the project portfolio.</p> <p>6B - Presents the project and the design process used.</p> <p>6C - Evaluates each team member in the elements of cooperation, division of labor and preparation.</p> <p>6D - Evaluates himself in conceptual understanding, strategies and reasoning, equipment and materials and work habits.</p>	<p><u>Career Technical Education:</u> *ED/ETP/ D5.1 Understand the steps in the design process. D5.2 Determine what information and principles are relevant to a problem and its analysis. D10.1 Understand the process of product development. D10.2 Understand charting and the use of graphic tools in illustrating the development of a product and the processes involved. *ED/LT/ 9.1 Understand the characteristics and benefits of teamwork, leadership, and citizenship in the school, community, and workplace settings. 9.3 Understand how to organize and structure work individually and in teams for effective performance and the attainment of goals. 9.4 Know multiple approaches to conflict resolution and their appropriateness for a variety of situations in the workplace. 9.5 Understand how to interact with others in ways that demonstrate respect for individual and cultural differences and for the attitudes and feelings of others. *ED/EDP/ C11.1 Develop a binder of representative student work for presentation. C11.2 Produce a compact disc, Web site, or other digital-media portfolio. C11.3 Know how to give an effective oral presentation of a portfolio. *ED/ETP/ D1.5 Prepare reports and data sheets for writing specifications.</p>	<p>6A Project Portfolio 6B Process and Results Presentation 6C Team Evaluation 6D Personal Evaluation</p>	<p><u>Teacher and Student Resources:</u> *Supplemental Instructional Materials: -Technical Drawing by Giesecke, Mitchell, Spencer, Hill, Dygdon, & Novak, Prentice Hall, latest edition -Technology; Design and Applications by R. Thomas Wright, Rayan A. Brown, The Goodheart-Willcox Publisher, latest edition -Manufacturing & Automation Technology by R Thomas Wright, The Goodheart-Willcox Publisher, latest edition -Physics, Principles with Applications by Douglas C. Giancoli, , Prentice Hall, latest edition -AutoCAD, Solid Works, COSMOS Works, Solid Works Animator, latest software editions</p>

CTE/ROP Engineering Research And Development (EDD)

	<p><u>Core Academic:</u> *M/AI/G8-12/ 24.2 Students identify the hypothesis and conclusion in logical deduction.</p>		
--	---	--	--

CTE/ROP Engineering Research And Development (EDD)

<u>Semester 2 - Unit 6 – Career Development (8 hours)</u>			
Competencies	Standards	Suggested Pacing	Resources/Materials
<p>1A - Accessing and utilizing technology and information</p> <p>1B - Practicing occupational safety standards</p> <p>1C - Thinking critically and solving problems effectively</p> <p>1D - Using basic skills in reading, writing, mathematics, listening and speaking as they relate to occupation specific skills</p> <p>1E - Attaining a comprehensive understanding of all aspects of industry the individual is preparing to enter</p> <p>1F - Applying knowledge to real world problems and situations.</p> <p>2A - Works independently and collaboratively.</p> <p>2B - Communicates effectively and appropriately.</p> <p>2C - Performs reliably and responsibly.</p> <p>2D - Working with diverse populations effectively and respectfully</p> <p>2E - Is punctual.</p> <p>2F - Follows directions.</p> <p>2G - Works well with minimum supervision.</p> <p>2H - Is cooperative.</p> <p>2I - Takes initiative by working beyond minimum requirements.</p> <p>2J - Meets job standards of</p>	<p><u>Career Technical Education:</u> *ED/CPM/ 3.1 Know the personal qualifications, interests, aptitudes, knowledge, and skills necessary to succeed in careers. 3.2 Understand the scope of career opportunities and know the requirements for education, training, and licensure. 3.6 Know important strategies for self-promotion in the hiring process, such as job applications, résumé writing, interviewing skills, and preparation of a portfolio.</p> <p><u>Core Academic:</u> *ED/A/1.4VPA/VA/ADV/G9-12/ (5.3) Prepare portfolios of their original works of art for a variety of purposes (e.g., review for postsecondary application, exhibition, job application, and personal collection). *ED/C/2.2W/WSA/G11-12/ (2.5) Write job applications and résumés: a. Provide clear and purposeful information and address the intended audience appropriately. b. Use varied levels, patterns, and types of language to achieve intended effects and aid comprehension. c. Modify the tone to fit the purpose and audience. d. Follow the conventional style for that type of document (e.g., résumé, memorandum) and use page formats, fonts, and spacing that contribute to the readability and impact of the document. *ED/C/2.3WO/ELC/G11-12/ (1.2) Produce legible work that shows accurate spelling and correct punctuation and capitalization.</p>	<p>A: Occupational Knowledge and Skills B: Workplace Skills and Behavior</p>	

CTE/ROP Engineering Research And Development (EDD)

<p>neatness and grooming. 2K - Responds appropriately to constructive criticism.</p>	<p>*ED/C/2.2W/WSA/G11-12/ (1.6) Develop presentations by using clear research questions and creative and critical research strategies (e.g., field studies, oral histories, interviews, experiments, electronic sources).</p>		
---	---	--	--

CTE/ROP Engineering Research And Development (EDD)

<u>Semester 2 - Unit 8 – Job Acquisition Skills (2 hours)</u>			
Competencies	Standards	Suggested Pacing	Resources/Materials
<p>3A - Completing an appropriate resume and job application</p> <p>3B - Acquiring job interview techniques</p> <p>3C - Attaining awareness of advanced career and educational opportunities</p>	<p><u>Career Technical Education:</u> *ED/CPM/ 3.1 Know the personal qualifications, interests, aptitudes, knowledge, and skills necessary to succeed in careers. 3.2 Understand the scope of career opportunities and know the requirements for education, training, and licensure. 3.6 Know important strategies for self-promotion in the hiring process, such as job applications, résumé writing, interviewing skills, and preparation of a portfolio.</p> <p><u>Core Academic:</u> *ED/C/2.2W/WSA/G11-12/ (2.5) Write job applications and résumés: a. Provide clear and purposeful information and address the intended audience appropriately. b. Use varied levels, patterns, and types of language to achieve intended effects and aid comprehension. c. Modify the tone to fit the purpose and audience. d. Follow the conventional style for that type of document (e.g., résumé, memorandum) and use page formats, fonts, and spacing that contribute to the readability and impact of the document.</p>	<p>A: Resume B: Job Interview C: Career Opportunities</p>	