CTE/ROP Pre-Engineering & Design 1 & 2

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

Course Length: 2 Semesters	**Classroom Instruction:** 180 hours
SUHSD Course Number:	**Grade Level:** 10, 11, 12
SDCOE Course Number:	**SDCOE Total Hours:**
CBEDS Number/Title:	**Year of Implementation:**
Course Pre-requisites: Algebra I **Co-Requisites:** Geometry or Algebra II	**Articulation (school/credits):** None
CTE Industry Sector: Engineering and Design	**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: **Supplemental Instructional Materials:** Technical Drawing by Giesecke, Mitchell, Spencer, Hill, Dygdon, & Novak, Prentice Hall, latest edition	
Course Description: Pre-Engineering and Design students will investigate the various aspects of the engineering field with special emphasis in design and understanding of physical science principles. Fundamentals of engineering theory will be emphasized through the types of materials used in engineering and their applications as well as concepts in science, mathematics as it relates to engineering design. Students will use the tools and technologies of the engineering trade to design and conduct meaningful science and engineering investigations. Engineering investigations and projects will be rooted in real, local environmental areas of concern, and promote exploration for the connections between science and society. This course is aligned with the Career Technical Education, Physics and Mathematics standards.	

CTE/ROP Pre-Engineering & Design 1 & 2

Semester 1

Unit 1: Introduction To Engineering
Unit 2: Engineering Design And Visual Communication (Engineering Drawing Fundamentals)
Unit 3: Engineering Design And Visual Communication (2d CADD)
Unit 4: Engineering Fundamentals
Unit 5: Math Concepts

Semester 2

Unit 1: Additional Math Concepts
Unit 2: Product Development
Unit 3: Analysis of Engineering Concepts & Product Development
Unit 4: Software
Unit 5: Career Development
Unit 6: Job Acquisition Skills

Semester 1 - **Unit 1 – Introduction To Engineering (5 hours)**			
Competencies	**Standards**	**Suggested Pacing**	**Resources/Materials**
1A - Understands job duties of various types of engineers. **1B -** Knows the key achievements of engineering throughout history. **1C -** Knows significant engineers that had an impact on the field of engineering.	**Career Technical Education:** ***ED/EDP/** **C1.1** Know historical and current events that have relevance to engineering design. **C1.2** Understand the development of graphic language in relation to engineering design. **Core Academic:** ***M/AI/G8-12/** **5.0** Students solve multistep problems, including word problems, involving linear equations and linear inequalities in one variable and provide justification for each step. ***M/GM/G8-12/** **11.0** Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids.	**1A:** Definition of an engineer & types of engineers **1B:** History of engineering and its impact on society **1C:** Profiles of historical engineers **1D:** Current events and challenges related to engineering and its potential impact on society	**Teacher and Student Resources:** **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

Semester 1 - **Unit 2 – Engineering Design And Visual Communication (Engineering Drawing Fundamentals) (15 hours)**

Competencies	Standards	Suggested Pacing	Resources/Materials
2A - Sketches objects in orthographic projection and pictorials. **2B -** Measures in metric and English measurement systems. **2C -** Knows projection techniques used to develop orthographic projection with traditional and computer aided means. **2D -** Applies geometry related to engineering drawings. **2E -** Understands and applies proper dimensioning to engineering drawings. **2F -** Applies tolerances related to engineering drawings and understand their impact on parts and mating parts as it applies to engineering design. **2G -** Draws sectional views. **2H -** Draws auxiliary views. **2I -** Draws various types of pictorial drawings used in engineering drawings. **2J -** Draws assembly drawings.	**Career Technical Education:** ***ED/EDP/** **C1.2** Understand the development of graphic language in relation to engineering design. **C3.1** Know how the various measurement systems are used in engineering drawings. **C3.2** Understand the degree of accuracy necessary for engineering design. **C4.1** Understand the commands and concepts necessary for producing drawings through traditional or computer-aided means. **C4.2** Understand the orthographic projection process for developing multiview drawings. **C4.3** Understand the various techniques for viewing objects. **C4.4** Use the concepts of geometric construction in the development of design drawings. **C4.5** Apply pictorial drawings derived from orthographic multiview drawings and sketches and from a solid modeler. **C5.1** Understand the commands and concepts necessary for editing engineering drawings. **C5.3** Know the CADD components and the operational functions of CADD systems. **C5.5** Understand how to determine properties of drawing objects. **C6.1** Know a variety of drafting applications and understand the proper dimensioning styles for each. **C6.2** Apply dimensioning to various objects and features. **C6.3** Edit a dimension by using various editing methods. **C7.1** Understand the function of sectional views.	**2A:** Sketching process used in concept development **2B:** Understanding measurement systems as they apply to engineering design **2C:** Projection techniques used to develop orthographic projection with traditional and computer aided means Geometry related to engineering drawings **2D:** Understanding and application of proper dimensioning to engineering drawings **2E:** Tolerances related to engineering drawings and their impact on parts and mating parts as it applies to engineering design **2F**: Sectional views **2G:** Auxiliary views **2H:** Types of pictorial drawings used in engineering drawings **2I:** Assembly drawings	**Teacher and Student Resources:** **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

	C7.2 Use a sectional view and appropriate cutting planes to clarify hidden features of an object. **C8.1** Understand what constitutes mating parts in engineering design. **C8.2** Use tolerancing in an engineering drawing. **C8.3** Interpret geometric tolerancing symbols in a drawing. **C9.1** Understand the processes of lettering and text editing. **C9.2** Develop drawings using notes and specifications. **C9.3** Understand the methods of title block creation. **C10.1** Understand the process of producing proportional two- and three-dimensional sketches and designs. **C10.2** Use sketching techniques as they apply to a variety of architectural and engineering models. **C10.3** Use freehand graphic communication skills to represent conceptual ideas, analysis, and design concepts. **Core Academic:** ***M/AI/G8-12/** **5.0** Students solve multistep problems, including word problems, involving linear equations and linear inequalities in one variable and provide justification for each step. **7.0** Students verify that a point lies on a line, given an equation of the line. Students are able to derive linear equations by using the point-slope formula. **8.0** Students understand the concepts of parallel lines and perpendicular lines and how those slopes are related. Students are able to find the equation of a line perpendicular to a given line that passes through a given point. ***M/GM/G8-12/** **1.0** Students demonstrate understanding by identifying and giving examples of undefined		

	terms, axioms, theorems, and inductive and deductive reasoning. **4.0** Students prove basic theorems involving congruence and similarity. **5.0** Students prove that triangles are congruent or similar, and they are able to use the concept of corresponding parts of congruent triangles. **7.0** Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of circles. **8.0** Students know, derive, and solve problems involving the perimeter, circumference, area, volume, lateral area, and surface area of common geometric figures. **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. **10.0** Students compute areas of polygons, including rectangles, scalene triangles, equilateral triangles, rhombi, parallelograms, and trapezoids. **11.0** Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids. **12.0** Students find and use measures of sides and of interior and exterior angles of triangles and polygons to classify figures and solve problems. **13.0** Students prove relationships between angles in polygons by using properties of complementary, supplementary, vertical, and exterior angles. **16.0** Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line.		

	20.0 Students know and are able to use angle and side relationships in problems with special right triangles, such as 30°, 60°, and 90° triangles and 45°, 45°, and 90° triangles. **21.0** Students prove and solve problems regarding relationships among chords, secants, tangents, inscribed angles, and inscribed and circumscribed polygons of circles. **22.0** Students know the effect of rigid motions on figures in the coordinate plane and space, including rotations, translations, and reflection.		

Semester 1 - **Unit 3 – Engineering Design And Visual Communication (2d CADD) (50 hours)**

Competencies	Standards	Suggested Pacing	Resources/Materials
3A - Creates engineering drawings on CADD. **3B -** Uses and understands measurement systems used on CADD. **3C -** Applies tolerances on CADD. **4A -** Creates parts. **4B -** Creates assemblies of a product. **4C -** Creates mating parts, defining tolerances of parts, defining relationships of parts, and features of parts. **4D -** Understands range of motion of parts and assemblies. **4E -** Edits 3D models as needed in the engineering design process. **4F -** Produces engineering drawings from 3D models. **4G -** Produces animations of 3D models. **4H -** Conducts engineering tests on 3D models.	**Career Technical Education:** ***ED/EDP/** **C2.1** Use the appropriate methods and techniques for employing all engineering design equipment. **C2.2** Apply conventional engineering design processes and procedures accurately, appropriately, and safely. **C2.3** Apply the concepts of engineering design to the tools, equipment, projects, and procedures of the Engineering Design Pathway. **C5.2** Know the various object-altering techniques. **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. ***ED/ETP/** **D1.1** Understand the classification and use of various electronic components, symbols, abbreviations, and media common to electronic drawings. **D1.2** Understand, organize, and complete an assembly drawing by using information collected from detailed drawings. **D1.3** Know the current industry standards for illustration and layout. **Core Academic:** ***M/AI/G8-12/** **15.0** Students apply algebraic techniques to solve rate problems, work problems, and percent mixture problems. **16.0** Students understand the concepts of a relation and a function, determine whether a	**3A:** Develop engineering drawings on CADD **3B:** Measurement systems used on CADD **3C:** Dimensioning and tolerances on CADD **3D:** 3D modeling 1. Create parts 2. Create assemblies of a product 3. Mating parts, defining 4. tolerances of parts, defining relationships of parts, and features of parts 5. Range of motion of parts and assemblies 6. Editing 3D models as needed in the engineering design process 7. Producing engineering drawings from 3D models 8. Produce animations of 3D models 9. Conduct engineering tests on 3D models **4A:** History of materials **4B:** Materials used in modern engineering 1. Metals & metal alloys 2. Ceramics 3. Polymers 4. Composites	**Teacher and Student Resources:** **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

	given relation defines a function, and give pertinent information about given relations and functions. **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.	5. Concrete 6. Wood **4C:** Applications of engineering materials: 1. Ferrous materials 2. Corrosion 3.Effects of temperatures 4. Heat treatments 5. Molds 6. Strength of materials 7. Tensile tests **4D:** Understanding concepts of physics that are fundamental to engineering: **4E:** Newton's laws as determined by specific projects. Emphasis is to be placed on the concepts of balanced forces, the relationship between acceleration, force and mass (2nd law), and vector analysis of force interactions **4F:** Conservation of Energy as determined by specific projects. Emphasis is to be placed on conversion of energy from one type to another esp. focusing on potential, kinetic, and heat energy. Students will also understand the different types of collisions and the variables related to impulse and momentum, esp. as related to everyday life (airbags, bumpers etc.).	

		4G: Heat and Thermodynamics (heat transfer, engines, etc.), Waves and Energy transfer, Electric and Magnetic Phenomena.	

Semester 1 - **Unit 4 – Engineering Fundamentals (50 hours)**			
Competencies	**Standards**	**Suggested Pacing**	**Resources/Materials**
5A - Understands the history & development of materials applied to engineering. **5B -** Understands how materials such as metals, metal alloys, ceramics, polymers, composites, concrete, & wood are commonly used in engineering. **5C -** Understands applications of engineering materials including ferrous materials, corrosion, effects of temperature, heat treatment, molds, strengths of materials, & tensile tests. **5D -** Understands Newton's laws as determined by specific projects. Emphasis is to be placed on the concepts of balanced forces, the relationship between acceleration, force and mass (2nd law), and vector analysis of force interactions. **5E -** Understands Conservation of Energy as determined by specific projects. Emphasis is to be placed on conversion of energy from one type to another esp. focusing on potential, kinetic, and heat energy. **5F -** Understands the different	**Career Technical Education:** ***ED/EDP/** **C2.1** Use the appropriate methods and techniques for employing all engineering design equipment. ***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. **D7.3** Analyze the fundamentals and properties of waveforms and how waveforms may be used to carry energy. **Core Academic:** ***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. **7.0** Students compute the variance and the standard deviation of a distribution of data. ***S/PH/G8-12/** **1.** Newton's laws predict the motion of most objects. As a basis for understanding this concept: **a.** Students know how to solve problems that involve constant speed and average speed.	**5A:** History & Development of Materials **5B:** Heat Transfer **5C:** Conservation of Energy	**Teacher and Student Resources:** **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

types of collisions and the variables related to impulse and momentum, especially as related to everyday life (airbags, bumpers etc). **5G -** Understands Heat and Thermodynamics (heat transfer, engines, etc), Waves and Energy transfer, Electric and Magnetic Phenomena.	**b.** Students know that when forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest (Newton's first law). **c.** Students know how to apply the law F=ma ma to solve one-dimensional motion problems that involve constant forces (Newton's second law). **d.** Students know that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction (Newton's third law). **e.** Students know the relationship between the universal law of gravitation and the effect of gravity on an object at the surface of Earth. **f.** Students know applying a force to an object perpendicular to the direction of its motion causes the object to change direction but not speed (e.g., Earth's gravitational force causes a satellite in a circular orbit to change direction but not speed). **g.** Students know circular motion requires the application of a constant force directed toward the center of the circle. **2.** The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects. As a basis for understanding this concept: **a.** Students know how to calculate kinetic energy by using the formula $E=(1/2)mv^2$. **b.** Students know how to calculate changes in gravitational potential energy near Earth by using the formula (change in potential energy) =mgh (h is the change in the elevation). **c.** Students know how to solve problems involving conservation of energy in simple systems, such as falling objects. **d.** Students know how to calculate momentum as the product mv. **e.** Students know momentum is a separately conserved quantity different from energy. **f.** Students know an unbalanced force on an		

	object produces a change in its momentum. **g.** Students know how to solve problems involving elastic and inelastic collisions in one dimension by using the principles of conservation of momentum and energy. **h.*** Students know how to solve problems involving conservation of energy in simple systems with various sources of potential energy, such as capacitors and springs.		

Semester 1 – **Unit 5 Math Concepts – (10 hours)**			
Competencies	**Standards**	**Suggested Pacing**	**Resources/Materials**
5A - Solves multi-step problems, including word problems, involving linear equations and linear inequalities in one variable and provides justification for each step. **5B -** Verifies that a point lies on a line, given an equation of the line. **5C -** Derives linear equations by using the point-slope formula. **5D -** Understands the concepts of parallel lines and perpendicular lines and how those slopes are related. **5E -** Finds the equation of a line perpendicular to a given line that passes through a given point. **5F -** Solves a quadratic equation by factoring or completing the square. **5G -** Applies algebraic techniques to solve rate problems, work problems, and percent mixture problems. **5H -** Understands the concepts of a relation and a function, determining whether a given relation defines a function, and gives pertinent information about given relations and functions. **5I -** Determines the domain of	**Career Technical Education:** ***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. **Core Academic:** ***M/AI/G8-12/** **5.0** Students solve multistep problems, including word problems, involving linear equations and linear inequalities in one variable and provide justification for each step. **7.0** Students verify that a point lies on a line, given an equation of the line. Students are able to derive linear equations by using the point-slope formula. **8.0** Students understand the concepts of parallel lines and perpendicular lines and how those slopes are related. Students are able to find the equation of a line perpendicular to a given line that passes through a given point. **15.0** Students apply algebraic techniques to solve rate problems, work problems, and percent mixture problems. **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. **17.0** Students determine the domain of independent variables and the range of	**5A:** Linear Equations **5B:** Parallel Lines **5C:** Quadratic Equations **5D:** Functions	**Teacher and Student Resources:** **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

independent variables and the range of dependent variables defined by a graph, a set of ordered pairs, or a symbolic expression. **5J -** Demonstrates understanding of simple aspects of a logical argument. **5K -** Explains the difference between inductive and deductive reasoning and identifies and provides examples of each. **5L -** Identifies the hypothesis and conclusion in logical deduction. 24.3. **5M -** Uses counterexamples to show that an assertion is false and recognizes that a single counterexample is sufficient to refute an assertion.	dependent variables defined by a graph, a set of ordered pairs, or a symbolic expression. **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.		

Semester 2 - **Unit 1 – Additional Math Concepts (10 hours)**			
Competencies	**Standards**	**Suggested Pacing**	**Resources/Materials**
6A - Understands properties of the number system to judge the validity of results, to justify each step of a procedure, and to prove or disprove statements. **6B -** Uses properties of numbers to construct simple, valid arguments (direct and indirect) for, or formulate counterexamples to, claimed assertions. **6C -** Proves basic theorems involving congruence and similarity. **6D -** Proves that triangles are congruent or similar, and they are able to use the concept of corresponding parts of congruent triangles. **6E -** Proves and uses theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of circles. **6F -** Knows, derives, and solves problems involving the perimeter, circumference, area, volume, lateral area, and surface area of common geometric figures. **6G -** Computes the volumes and surface areas of prisms, pyramids, cylinders, cones, and spheres; and students commit to memory the	**Career Technical Education:** ***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. **Core Academic:** ***M/GM/G8-12/** **4.0** Students prove basic theorems involving congruence and similarity. **8.0** Students know, derive, and solve problems involving the perimeter, circumference, area, volume, lateral area, and surface area of common geometric figures. **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. **10.0** Students compute areas of polygons, including rectangles, scalene triangles, equilateral triangles, rhombi, parallelograms, and trapezoids. **11.0** Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids. **12.0** Students find and use measures of sides and of interior and exterior angles of triangles and polygons to classify figures and solve problems.	**A:** Defining the engineering problem & engineering process: 1. Identify the problem. 2. Define the goal-set benchmarks. **3.** Research & gather data – look at previous design solutions. 4. Do marketing research & surveys. 5. Analyze data. 6. Develop sketches, drawings, 3D models. a. Develop models & test prototypes. b. Analyze test results, make changes & choices. c. Communicate final design for production. d. Implement & commercialize. e. Prepare post-implementation review & assessment.	**Teacher and Student Resources:** **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

formulas for prisms, pyramids, and cylinders. **6H -** Computes areas of polygons, including rectangles, scalene triangles, equilateral triangles, rhombi, parallelograms, and trapezoids. **6I -** Determines how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids. **6J -** Finds and uses measures of sides and of interior and exterior angles of triangles and polygons to classify figures and solve problems. **6K -** Proves relationships between angles in polygons by using properties of complementary, supplementary, vertical, and exterior angles. **6L -** Uses the Pythagorean theorem to determine distance and find missing lengths of sides of right triangles. **6M -** Performs basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line. **6N -** Uses angle and side relationships in problems with special right triangles, such as 30°, 60°, and 90° triangles and 45°, 45°, and 90°	**13.0** Students prove relationships between angles in polygons by using properties of complementary, supplementary, vertical, and exterior angles. **15.0** Students use the Pythagorean theorem to determine distance and find missing lengths of sides of right triangles. **16.0** Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line. **20.0** Students know and are able to use angle and side relationships in problems with special right triangles, such as 30°, 60°, and 90° triangles and 45°, 45°, and 90° triangles. **22.0** Students know the effect of rigid motions on figures in the coordinate plane and space, including rotations, translations, and reflections. ***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.		

triangles. **6O -** Knows the effect of rigid motions on figures in the coordinate plane and space, including rotations, translations, and reflections. **6P -** Knows 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. **6Q -** Knows the definition of conditional probability and use it to solve for probabilities in finite sample spaces. **6R -** Computes the variance and the standard deviation of a distribution of data. **6S -** Defines an engineering problem & use a 10 step engineering process to create solutions to the problem			

Semester 2 - **Unit 2 – Product Development (20 hours)**			
Competencies	**Standards**	**Suggested Pacing**	**Resources/Materials**
7A - Develops 3D product models as a solution to an engineering problem. **7B -** Develops product prototypes as a solution to an engineering problem. **7C -** Analyzes the design process & product by means of scientific analysis, scientific data, & common engineering standards.	**Career Technical Education:** ***ED/ETP/** **D6.1** Know the common structure and processes of a quality assurance cycle. **D6.2** Understand the major manufacturing processes. **D6.3** Use tools, fasteners, and joining systems employed in selected engineering processes. **D6.5** Calibrate and measure objects by using precision measurement tools and instruments. **D11.1** Use methods and techniques for employing all engineering technology equipment appropriately. **D11.2** Apply conventional engineering technology processes and procedures accurately, appropriately, and safely. **D11.3** Apply the concepts of engineering technology to the tools, equipment, projects, and procedures of the Engineering Technology Pathway. **Core Academic:** ***S/PH/G8-12/** **1.** Newton's laws predict the motion of most objects. As a basis for understanding this concept: **a.** Students know how to solve problems that involve constant speed and average speed. **b.** Students know that when forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest (Newton's first law). **c.** Students know how to apply the law F=ma ma to solve one-dimensional motion problems that involve constant forces (Newton's second law). **d.** Students know that when one object exerts a force on a second object, the second object	**7A:** Develop product models **7B:** Develop product prototypes	**Teacher and Student Resources:** **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

	always exerts a force of equal magnitude and in the opposite direction (Newton's third law). **e.** Students know the relationship between the universal law of gravitation and the effect of gravity on an object at the surface of Earth. **f.** Students know applying a force to an object perpendicular to the direction of its motion causes the object to change direction but not speed (e.g., Earth's gravitational force causes a satellite in a circular orbit to change direction but not speed). **g.** Students know circular motion requires the application of a constant force directed toward the center of the circle. **2.** The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects. As a basis for understanding this concept: **a.** Students know how to calculate kinetic energy by using the formula E=(1/2)mv2. **b.** Students know how to calculate changes in gravitational potential energy near Earth by using the formula (change in potential energy) =mgh (h is the change in the elevation). **c.** Students know how to solve problems involving conservation of energy in simple systems, such as falling objects. **d.** Students know how to calculate momentum as the product mv. **e.** Students know momentum is a separately conserved quantity different from energy. **f.** Students know an unbalanced force on an object produces a change in its momentum. **g.** Students know how to solve problems involving elastic and inelastic collisions in one dimension by using the principles of conservation of momentum and energy. **h.*** Students know how to solve problems involving conservation of energy in simple systems with various sources of potential energy, such as capacitors and springs.		

Semester 2 - **Unit 3 – Analysis Of Engineering Concepts & Product Development (20 hours)**			
Competencies	**Standards**	**Suggested Pacing**	**Resources/Materials**
8A - The student Communicates a design problem & the process to find solutions to that problem by Effectively using technical writing & oral communication skills. **8B -** The student Communicates a design problem & the process to find solutions to that problem by Presenting ideas and solutions using word processing software. **8C -** The student Communicates a design problem & the process to find solutions to that problem by Presenting ideas and solutions using PowerPoint software. **8D -** The student Communicates a design problem & the process to find solutions to that problem by Developing a formal engineering report.	**Career Technical Education:** ***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. **Core Academic:** ***M/AI/G8-12/** **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.	**1:** Analyze the design process & product by means of scientific analysis, scientific data, & common engineering standards. **2:**Develop an engineering report: A. Technical writing & oral communication 1. Effective written & oral communication 2. Word processing 3. PowerPoint presentations 4. Developing a formal report 5. Presentation of a formal report	**Teacher and Student Resources:** **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

Semester 2 - **Unit 4 – Software (30 hours)**			
Competencies	**Standards**	**Suggested Pacing**	**Resources/Materials**
9A - The student is proficient in the use of AutoCAD **9B -** The student is proficient in the use of Solid Works **9C -** The student is proficient in the use of COSMOS **9D -** The student is proficient in the use of Word **9E -** The student is proficient in the use of PowerPoint	**Career Technical Education:** ***ED/ETP/** **D8.3** Understand the ethical issues in computer engineering. **D8.4** Know the function and interaction of basic computer components and peripherals. **D8.5** Understand the relationship among computer hardware, networks, and operating systems. **D11.1** Use methods and techniques for employing all engineering technology equipment appropriately. **D11.3** Apply the concepts of engineering technology to the tools, equipment, projects, and procedures of the Engineering Technology Pathway. **Core Academic:** ***ED/C/2.3WO/ELC/G11-12/** **(1.2)** Produce legible work that shows accurate spelling and correct punctuation and capitalization.	**9A:** Autocad **9B:** Solid Works **9C:** COSMOS **9D:** MS Word **9E:** MS Power Point	**Teacher and Student Resources:** **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

Semester 2 - **Unit 5 – Career Development (7 hours)**			
Competencies	**Standards**	**Suggested Pacing**	**Resources/Materials**
1A - Accessing and utilizing technology and information **1B** - Practicing occupational safety standards **1C** - Thinking critically and solving problems effectively **1D** - Using basic skills in reading, writing, mathematics, listening and speaking as they relate to occupation specific skills **1E** - Attaining a comprehensive understanding of all aspects of industry the individual is preparing to enter **1F** - Applying knowledge to real world problems and situations. **2A** - Works independently and collaboratively. **2B** - Communicates effectively and appropriately. **2C** - Performs reliably and responsibly. **2D** - Working with diverse populations effectively and respectfully **2E** - Is punctual. **2F** - Follows directions. **2G** - Works well with minimum supervision. **2H** - Is cooperative. **2I** - Takes initiative by working beyond minimum requirements. **2J** - Meets job standards of	**Career Technical Education:** ***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. **Core Academic:** ***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.	**A:** Occupational Knowledge and Skills **B:** Workplace Skills and Behavior	**Teacher and Student Resources:** **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

neatness and grooming. **2K** - Responds appropriately to constructive criticism.	***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).		

Semester 2 - **Unit 6 – Job Acquisition Skills (3 hours)**			
Competencies	**Standards**	**Suggested Pacing**	**Resources/Materials**
3A - Completing an appropriate resume and job application **3B** - Acquiring job interview techniques **3C** - Attaining awareness of advanced career and educational opportunities	**Career Technical Education:** ***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. **Core Academic:** ***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.	**A:** Resume **B:** Job Interview **C:** Career Opportunities	**Teacher and Student Resources:** **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