CTE/ROP Principles of Engineering 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: 97249/97250	**Grade Level:** 9, 10, 11, 12
SDCOE Course Number: 578311	**SDCOE Total Hours:** 180 hours
CBEDS Number/Title: 5704/Civil-Structural Drafting	**Year of Implementation:** 2011
Course Pre-requisites: ROP Introduction to Engineering	**Articulation (school/credits):** Southwestern College/Up to 3 Credits
CTE Industry Sector: Engineering and Design	**CTE Pathway(s):** Architectural and Structural Engineering, Engineering Design, Engineering Technology
Job Titles: Engineer, Designer, Manufacturer, Computer Designer, Structural Engineer, Drafter	
Credential Information: Preliminary or Clear Full-Time Designated Subjects CTE Teaching Credential in Engineering Design	
Required Textbooks: None	
Course Description: Principles of Engineering (POE) is a high school-level survey course of engineering. The course exposes students to some of the major concepts that they will encounter in a postsecondary engineering course of study. Students have an opportunity to investigate engineering and high tech career. POE gives students the opportunity to develop skills and understanding of course concepts through activity-, project-, and problem-based (APPB) learning. Used in combination with a teaming approach, APPB learning challenges students to continually hone their interpersonal skills, creative abilities, and problem solving skills based upon engineering concepts. It also allows students to develop strategies to enable and direct their own learning, which is the ultimate goal of education. Employment possibilities include entry level Engineering, design, manufacturing, computer design, research and development (R&D), architecture, digital manufacturing, field engineer and drafter. Instruction covers the following areas: Engineering principals, engineering technology systems, math, science, problem solving, and computer aided design. Students use equipment which includes: Dial gauges, protractors, engineering rulers, computers, plotters and 3-d printers.	

CTE/ROP Principles of Engineering 1/2

Semester 1

Unit A: Career Development
Unit 1: Energy and Power
- Lesson 1.1 Mechanisms
- Lesson 1.2 Energy Sources
- Lesson 1.3 Energy Applications
- Lesson 1.4 Design Problem – Energy and Power

Unit 2 Materials and Structures
- Lesson 2.1 Statics
- Lesson 2.2 Material Properties
- Lesson 2.3 Material Testing
- Lesson 2.4 Design Problem – Materials and Structures

Semester 2

Unit B: Career Development
Unit 3 Control Systems
- Lesson 3.1 Machine Control
- Lesson 3.2 Fluid Power
- Lesson 3.3 Design Problem – Control Systems

Unit 4 Statistics and Kinematics
- Lesson 4.1 Statistics
- Lesson 4.2 Kinematics
- Lesson 4.3 Design Problem – Statistics and Kinematics

Semester 1 - **Unit A - Career Development (10 hours)**				
Competencies	**Standards**	**Suggested Pacing**	**Essential Vocabulary**	**Resources/Materials**
A - Completes an appropriate resume and job application. **B** - Acquires job interview techniques. **C** - Attains 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/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,	**A - 3 hours:** Resume and **2 hours**: Job Application **B – 2.5 hours:** Job interviews **C - 2.5 hours:** Career awareness	Career Characteristics Convicted Description Disability Extracurricular Interview skills Job Application Job Interview Labor Laws Limitations Objective Position Portfolio Previous/Former Reference Referred Resume Salary Skills Strengths	**Teacher Resources:** Job Finder's Guide Employability Skills Handbook (lesson plan examples) http://www.baldyviewrop.com/teachers_staff/lesson_plans.htm **Student Resources:** Master Application Job Finder's Guide www.snagajob.com www.monster.com http://www.ca.gov/Jobs/

	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. ***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).			

Suggestions/Assessments:

Resume/Job Application/Letters

- Have students start by writing a Personal Statement (See Job Finder's Guide)
- Have students properly request a job application in person, and/or print one from the Internet. Students should fill out and complete the application. Also have students complete an online job application for a company.
- Use technology to show students exemplary and poor-quality examples of resumes, cover letters, and follow-up letters. Identify the components of business letters and a resume. Have students identify errors in the examples.
- Show Resume PowerPoint presentation and have students fill out a Resume Worksheet with all the information they will need to type in their Resume in order to best prepare and complete the Resume Document.
- Have students prepare a Cover Letter Document, References Document, and Thank you letter Document.

Job Interviews

- Have students type up responses to interview questions. Have students practice with a partner, then present in front of the class.
- Have students participate in mock interviews.

Career Awareness

- Have students visit selected college and university Web sites to discover what courses are taught and what majors are offered in the field of information technology.
- Have students share their findings with the class using electronic presentation software.
- Have students use the online *Occupational Outlook Handbook* (http://www.bls.gov/oco/) to select an area of occupational interest. Have them research salary and educational requirements for the chosen career and then prepare a one-page summary of the information using word processing software or do a multimedia presentation using presentation software, such as Microsoft PowerPoint.
- Have students understand:
  - Keeping informed of the job market will ensure that you have every opportunity to obtain the best jobs available.
  - Well-prepared job candidates perform much better in the job application and interview process and are more likely to be hired for desirable positions.

- Have students conduct a job search.
- Guest Speakers: College representatives, Professional in the Industry

- The teacher will assess the Resume, Cover Letter, References Page and Thank you letter documents, and mock interviews.

Comments:

- At the beginning of the unit, use the **KWL Chart** to determine what students Know and what they Want to know about careers and emerging technologies in the industry. At the end of the unit, use K-W-L to review by having students recall what they have learned.

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Semester 1 - **Unit 1 – Energy and Power (59 hours)**				
Competencies	**Standards**	**Suggested Pacing**	**Essential Vocabulary**	**Resources/Materials**
1A - Calculates Mechanical Advantage of simple machines **1B** - Uses six simple machines to create a SMET devise. **1C** - Is able to explain calculations in presentation **1D** - Explain and uses Levers **1E** - Explains and uses inclined Plane **1F** - Explains and uses Wedge **1G** - Explains and uses Wheel and Axle **1H** - Explains and uses Pulley **1I** - Explains and uses Screw **1J** - Changes speed and direction using gears **1K** - Uses cams to change direction of motion	**Career Technical Education:** ***ED/LT/** **9.3** Understand how to organize and structure work individually and in teams for effective performance and attainment of goals. ***ED/EDP/** **C2.3** Apply the concepts of engineering design to the tools, equipment, projects, and procedures of the Engineering Design Pathway. **C11.3** Know how to give an effective oral presentation of a portfolio. ***ED/ETP/** **D4.1** Understand scalars and vectors. **D4.2** Solve problems by using the concept of vectoring to predict the resultant forces. **D4.3** Know the six simple machines and their applications. **D5.1** Understand the steps in the design process. **D5.2** Determine what information and principles are relevant to a problem and its analysis.	**Lesson 1.1 –** **15 hours:** Mechanisms	Wheel and Axle Wedge Torque Technical Communication Static Equilibrium Sprocket Simple Machine Screw Resistance Force Pulley Pitch Moment Mechanism Lever Inclined Plane Ideal Mechanical Advantage Idler Gear Gear Fulcrum Friction Efficiency Effort Force Chain Career Belt ABET Actual Mechanical Advantage	**Teacher Resources** Refer to Suggestions/ Assessments section. **Student Resources** Refer to Suggestions/ Assessments section.

Suggestions/Assessments:
Lesson 1.1

Section 1 (1 hour)

- The teacher will distribute course and school specific materials relating to Principles Of Engineering course expectations and procedures.
- The teacher will distribute an engineer's notebook to each student or have students create their own.
- **Note:** The teacher will determine whether students will record their notes in a daily journal, portfolio, or their engineer's notebook. For purposes of written directions in the day-by-day for each lesson in this course, it will be assumed that students will record their notes in a journal. The journal may be a three-ring binder, spiral bound notebook, or electronic.
- The teacher will distribute Sample Engineer's Notebook Entries to each student and discuss what constitutes acceptable and unacceptable entries.
- The teacher will present Engineer's Notebook.ppt**.**
- **Note:** The teacher may want to present the extended version of this presentation. The extended version is located in the Instructional Resources at the end of this lesson.

Section 2 (1 hour)

- The teacher will present Careers in Engineering and Engineering Technology.ppt**.**
- Students will take notes during the presentation in their journals.
- The teacher will distribute and explain Professional Interview and Professional Interview Rubric.
- The teacher will lead a discussion about how to contact professionals to be interviewed and how to best conduct those interviews. Students will be given a due date for contacting the interviewee and for the Professional Interview activity to be completed and submitted.

Section 3 (1 hour)

- The teacher will present Concepts**,** Key Terms, and Essential Questions to provide a lesson overview.
- The teacher will present Simple Machine – Lever, Wheel and Axle, and Pulley.ppt.
- Students will take notes during the presentation in their journals.
- **Optional:** The teacher may want to distribute Lesson 1.1 Key Terms Crossword for homework once the key terms have been introduced.

Section 4 (1 hour)

- The teacher will distribute Activity 1.1.1 Simple Machine Investigation.
- Students will work on Part 1 of Activity 1.1.1 Simple Machine Investigation.
- The teacher will circulate around the lab to be sure that the students are gathering accurate data.

Section 5 (1 hour)

- Students will complete Part 1 of Activity 1.1.1 Simple Machine Investigation.
- The teacher will circulate around the lab to be sure that the students are gathering accurate data.

Section 6 (1 hour)

- The teacher will present Simple Machines – Inclined Plane, Wedge, and Screw.ppt
- Students will take notes during the presentation in their journals.

Section 7 (1 hour)

- Students will work on Part 2 of Activity 1.1.1 Simple Machine Investigation.

Section 8 (1 hour)

- Students will complete Part 2 of Activity 1.1.1 Simple Machine Investigation.
- The teacher will collect Activity 1.1.1 Simple Machine Investigation.
- The teacher will assign Activity 1.1.2 Simple Machines Practice Problems for homework.
- Students will be given a copy of Understanding Thread Notes in order to complete Simple Machines Practice Problems.
- Students will begin working on Activity 1.1.2 Simple Machines Practice Problems.

Section 9 (1 hour)

- The teacher will collect Activity 1.1.2 Simple Machines Practice Problems.
- The teacher will present Gears, Pulley Drives, and Sprockets.ppt.
- Students will take notes during the presentation in their journals.

Section 10 (1 hour)

- The teacher will distribute Activity 1.1.3 Gears**.**
- Students will work on Activity 1.1.3 Gears.
- Students will document their design ideas generated for Activity 1.1.3 Gears in their journals.

Section 11 (1 hour)

- The teacher will review and collect Activity 1.1.3 Gears to assess student competence.
- The teacher will distribute Activity 1.1.4 Pulley Drives and Sprockets.
- Students will complete Activity 1.1.4 Pulley Drives and Sprockets.
- Students will be assigned Activity 1.1.5 Gear, Pulley Drives, and Sprocket Practice Problems for homework.

Section 12 (1 hour)

- The teacher will review and collect Activity 1.1.5 Simple Machines Practice Problems and Gears, Pulley Drives, and Sprockets Practice Problems to assess student competence.
- Students will be introduced to Project 1.1.6 Compound Machine Design**.**
- Students will be given a copy of Project 1.1.6 Compound Machine Design Rubric to review and later turn in for evaluation with their final documentation and design.

Section 13-15 (3 hour)

- In teams of two to three, students will design, build, and test their solutions to Problem 1.1.5 Compound Machine Design.
- The teacher may present Optional – Fischertechnik® Mechanisms.ppt to help students with brainstorming solutions.
- The teacher will evaluate Problem 1.1.5 Compound Machine Design.

Comments:

Semester 1 - **Unit 1 – Energy and Power**				
Competencies	**Standards**	**Suggested Pacing**	**Essential Vocabulary**	**Resources/Materials**
1L - Applies Ohm's and Watt's laws in designing safe electrical circuits. **1M** - Understands electron flow **1N** - Calculates resistance values **1O** - Estimates current consumption by a circuit and be able to compare estimates to accurate measurements they perform. **1P** - Uses metering devises to test circuits. **1Q** - Uses a simple motor generator to determine motor efficiency. **1R** - Demonstrates magnetic properties **1S** - Demonstrates magnetic properties using conductors	**Career Technical Education:** ***ED/LT/** **9.6** Understand how to organize, conduct, lead, and participate in student-centered activities and events through student-based organizations. ***ED/EDP/** **C2.3** Apply the concepts of engineering design to the tools, equipment, projects, and procedures of the Engineering Design Pathway. **C11.3** Know how to give an effective oral presentation of a portfolio. ***ED/ETP/** **D3.1** Analyze relationships between voltage, current, resistance, and power related to direct current (DC) circuits. **D3.5** Analyze and predict the effects of circuit conditions on the basis of measurements and calculations of voltage, current, resistance, and power. **D3.8** Calculate loads, currents, and circuit-operating parameters.	**Lesson 1.2 –** **11 hours:** Energy Sources	Alternative Energy Ampere Biomass Current Electrical Energy Electricity Electromagnetic Induction Efficiency Energy Energy Conversion Environmental Protection Agency Fossil Fuel Generator Geothermal Energy Energy Gravitational Induction Inexhaustible Energy Kinetic Energy Nonrenewable Energy Ohm Ohm's Law Parallel Circuit	**Teacher Resources** Refer to Suggestions/ Assessments section. **Student Resources** Refer to Suggestions/ Assessments section.

			Potential Energy Converter Power Power Grid Renewable Energy Resistance Work Turbine Power Voltage Series Circuit Volt Rotor	

Suggestions/Assessments:
Lesson 1.2

Section 1 (1 hour)

- The teacher will present Concepts**,** Key Terms, and Essential Questions to provide a lesson overview.
- The teacher will present Energy Sources.ppt.
- Students will take notes during the presentation in their journals.
- The teacher will distribute and explain Activity 1.2.1 Energy Sources and Activity 1.2.1 Energy Sources Rubric**.**
- The teacher will assign teams and facilitate topic selection so that students may begin work on Activity 1.2.1 Energy Sources.
- The teacher will announce what day the presentations will be given.
- The teacher will distribute and explain Activity 1.2.2 Energy Distribution in order to prepare students for a field trip to a local utility company. Note: If a local utility company visit is not possible, teachers can schedule a guest speaker or show students informational videos (e.g., The History Channel Modern Marvels DVD *The Power Grid* SKU ID #3849-68586 or *Greatest Inventions with Bill Nye – Energy* ISBN 1-50380-826-7).
- **Optional:** The teacher may want to distribute Lesson 1.2 Key Terms Crossword for homework once the key terms have been introduced.

Section 2 (1 hour)

- The teacher will present Introduction to Electricity.ppt.

- Students will take notes during the presentation in their journals.

Section 3 (1 hour)

- The teacher will finish presenting Introduction to Electricity.ppt.
- Students will take notes during the presentation in their journals.
- The teacher will distribute and explain Activity 1.2.3 Electrical Circuits**.**
- Students will begin Activity 1.2.3 Electrical Circuits.

Section 4 (1 hour)

- Students will work on Activity 1.2.3 Electrical Circuits.

Section 5 (1 hour)

- Students will complete Activity 1.2.3 Electrical Circuits.
- The teacher will distribute and explain Activity 1.2.4 Circuit Calculations.
- Students will work on Activity 1.2.4 Electrical Circuits and complete for homework.

Section 6 (1 hour)

- The teacher will collect and evaluate Activity 1.2.4 Electrical Circuits.
- The teacher and students will visit a local utility company in order to complete Activity 1.2.2 Energy Distribution. Note: If a local utility company visit is not possible, teachers can schedule a guest speaker or show students informational videos (e.g., The History Channel Modern Marvels DVD *The Power Grid* SKU ID #3849-68586 or *Greatest Inventions with Bill Nye – Energy* ISBN 1-50380-826-7).

Section 7(1 hour)

- The class will deliver presentations for Activity 1.2.1 Energy Sources.

Section 8 (1 hour)

- The teacher will present Work, Energy, and Power.ppt.
- Students will take notes during the presentation in their journals.

Section 9 (1 hour)

- The teacher will distribute and explain Activity 1.2.5a Mechanical Efficiency Winch.
- Students will begin Activity 1.2.5a Mechanical Efficiency Winch.

Section 10 (1 hour)

- Students will complete Activity 1.2.5a Mechanical Efficiency Winch.

- The teacher will distribute and explain Activity 1.2.5 Mechanical System Efficiency.
- Students will begin Activity 1.2.5 Mechanical System Efficiency.

Section 11 (1 hour)

- Students will complete Activity 1.2.5 Mechanical System Efficiency.

Comments:

Semester 1 - **Unit 1 – Energy and Power**				
Competencies	**Standards**	**Suggested Pacing**	**Essential Vocabulary**	**Resources/Materials**
1T - Uses unit of measure related to thermodynamics **1U** - Creates a poster presentation explaining six form of energy. (Mechanical, Chemical, Electromagnetic, Nuclear, Thermal and Solar. **1V** - Calculates the heat loss or gain using materials with different R Values. **1W** - Creates and present a flow diagram of a functional hydraulic system. **1X** - Calculates pressures on components. **1Y** - Constructs a functional pneumatic system using a trainer. **1Z** - Uses calculation to determine pressure and forces on the system.	**Career Technical Education:** ***ED/LT/** **9.3** Understand how to organize and structure work individually and in teams for effective performance and attainment of goals ***ED/EDP/** **C3.1** Know how the various measurement systems are used in engineering drawings. ***ED/ETP/** **D3.5** Analyze and predict the effects of circuit conditions on the basis of measurements and calculations of voltage, current, resistance, and power. **Core Academic:** ***ED/A/1.2S/PH/G9-12/** **(3.a)** Students know heat flow and work are two forms of energy transfer between systems.	**Lesson 1.3 –** **10 hours:** Energy Applications	Active Solar Energy Collection Alternative Energy Ampere Conduction Convection Current Electrical Energy Electricity Electromagnetic Energy Electrolysis Energy Entropy First Law of Thermodynamics Fuel Cell Stack Heat Kelvin Line of Best Fit Ohm Ohm's Law Passive Solar Energy Collection Product Development Lifecycle Radiation Renewable Energy Resistance R-value Second Law of Thermodynamics Temperature Thermal Equilibrium Thermodynamic System	**Teacher Resources** Refer to Suggestions/ Assessments section. **Student Resources** Refer to Suggestions/ Assessments section.

			Thermodynamics U-value Volt Voltage Zeroth Law of Thermodynamics	

Suggestions/Assessments:
Lesson 1.3

Section 1 (1 hour)

- The teacher will present **Concepts**, **Key Terms**, and **Essential Questions** to provide a lesson overview.
- The teacher will present **Hydrogen Fuel Cell.ppt**.
- Students will take notes during the presentation in their journals.
- The teacher will distribute and introduce **Activity 1.3.1a Solar Hydrogen Automobile** or similar activity depending upon classroom resources.
- The teacher will distribute and introduce **Activity 1.3.1 Solar Hydrogen System.**
- **Optional:** The teacher may want to distribute **Lesson 1.3 Key Terms Crossword** for homework once the key terms have been introduced.

Section 2-4 (3 hours)

- Student teams will complete the Activity 1.3.1a Solar Hydrogen Automobile.
- Students will complete Activity 1.3.1 Solar Hydrogen System.

Section 5-6 (2 hours)

- The teacher will distribute and introduce **Activity 1.3.3 Thermodynamics.**
- The teacher will present **Introduction to Thermodynamics.ppt**.
- Students will take notes during the presentation in their journals.
- Student will complete Activity 1.3.3 Thermodynamics.

Section 7-10 (4 hours)

- The teacher will distribute and introduce **Project 1.3.4 Renewable Insulation** and **Project 1.3.4 Renewable Insulation Rubric.**
- The teacher will place students into teams of two.
- Student teams will design, construct, and test recyclable house insulation.
- **Note:** Students must maintain a spreadsheet for the cost of insulation material, including all wasted material.
- Student teams will create a Product Development Lifecycle for the insulation material selected as homework, if necessary.
- Student teams will prepare a spreadsheet for the material cost of the house insulation as homework, if necessary.

- The teacher will assess student teams using Project 1.3.4Renewable Insulation Rubric.

Comments:

<table>
<tr><th colspan="5">Semester 1 - Unit 1 – Energy and Power</th></tr>
<tr><th>Competencies</th><th>Standards</th><th>Suggested Pacing</th><th>Essential Vocabulary</th><th>Resources/Materials</th></tr>
<tr>
<td>1AA - Understands the Product Development Lifecycle Chart
1BB - States problem clearly
1CC - Designs Brief to problem.
1DD - Examines evolution of an invention.
1EE - Uses simple techniques model problem.
1FF - Tests problem with appropriate methods.
1GG - Clearly presents solution to a group</td>
<td>Career Technical Education:
*ED/TC/
4.1 Understand past, present, and future technological advances as they relate to a chosen pathway
*ED/PSCT/
5.2 Understand the universal, systematic problem-solving model that incorporates input, process, outcome, and feedback components.
5.3 Use critical thinking skills to make informed decisions and solve problems.
*ED/LT/
9.3 Understand how to organize and structure work individually and in teams for effective performance and attainment of goals</td>
<td>Lesson 1.4 -
13 hours: Design Problem – Energy and Power</td>
<td>Accuracy
Assembly
Brainstorming
Component
Consensus
Constraint
Decision Matrix
Design Brief
Design Modification
Design Process
Design Statement
Designer
Open-Ended
Pictorial Sketch
Problem Statement
Purpose
Sketch
Solid Modeling
Target Consumer
Team</td>
<td>Teacher Resources
Refer to Suggestions/ Assessments section.

Student Resources
Refer to Suggestions/ Assessments section.</td>
</tr>
<tr>
<td colspan="5">Suggestions/Assessments:
Lesson 1.4

Section 1-2 (2 hours)

• The teacher will present Concepts, Key Terms, and Essential Questions to provide a lesson overview.
• The teacher will review the Professional Interview activity assigned in Lesson 1.1 Mechanisms. Students will complete the activity before the end of the unit. They may work on the activity during class as time allows. Additional work must be completed outside of class.
• The teacher will present Introduction to Design Briefs.ppt. Students will take notes in their journals.
• The teacher will divide the class into teams of four.
• The teacher will distribute and introduce Problem 1.4.1 Design Problem and Design Problem Rubric.
• The teacher will present Teamwork.ppt. Students will take notes in their journals.
• The teacher will review the design process used in this course by presenting Design Process Overview.ppt.
• Students will take notes during the presentation in their journals.</td>
</tr>
</table>

- The teacher will distribute **Example Design Process**. Students will keep the Example Design Process document available for reference during this lesson.
- The teacher will lead a class discussion to further refine the design statement, add additional constraints, identify available resources, and assign teams and team responsibilities.
- The teacher will present **Decision Matrix.ppt.** Students will take notes in their journals.
- The teacher will distribute and explain the **Decision Matrix Template**.
- The teacher will distribute and discuss **Design Modifications Chart** and **Citations in APA Style**.
- **Optional:** The teacher may want to distribute **Lesson 1.4 Key Terms Crossword.**

Section 3-13 (11 hours)

- Students will continue working on deliverables to be completed for Problem 1.4.1 Design Problem.
- The teacher will keep students on task and answer any questions during the process.
- Students will complete Problem 1.4.1 Design Problem.
- Students will demonstrate their solution to the class.
- The teacher will assess students using Decision Matrix Rubric and Design Problem Rubric.

Comments:

Semester 1 - **Unit 2 – Materials and Structures (40 hours)**				
Competencies	**Standards**	**Suggested Pacing**	**Essential Vocabulary**	**Resources/Materials**
2A - Defines describes and analyzes the stresses and forces acting on an object. **2B** - Designs, constructs and test a model bridge to supports the greatest amount of weight per gram of bridge mass.	**Career Technical Education:** ***ED/ENSEP/** **E4.1** Understand scalars and vectors. **E4.2** Solve problems by using the concept of vectoring to predict the resultant forces. **Core Academic:** ***ED/A/1.1M/GM/G8-12** **(15.0)** Students use the Pythagorean theorem to determine distance and find missing lengths of sides of right triangles. **(19.0)** Students use trigonometric functions to solve for an unknown length of a side of a right triangle, given an angle and a length of a side.	**Lesson 2.1 -** **14 hours:** Statics	Cable Centroid Compression Force Concurrent Force Systems Cross-Sectional Area Direction Fixed Support Flange Free Body Diagram Gusset Joint Magnitude Member Method of Joints Moment Moment of Inertia Newton's First Law Newton's Second Law Newton's Third Law Pinned Support Planar Truss Resultant Force Roller Support Scalar Sense Simple Truss Static Equilibrium Statically Indeterminate Structure Tension Force Vector Quantity	**Teacher Resources** Refer to Suggestions/ Assessments section. **Student Resources** Refer to Suggestions/ Assessments section.

Suggestions/Assessments:
Lesson 2.1

Section 1 (1 hour)

- The teacher will distribute and explain **Career Field Description** and **Career Field Description Rubric**.
- The teacher will lead a discussion about how to obtain information relating to engineering and engineering technology career fields. Students will be given a due date for the activity to be completed and submitted.
- The teacher will present **Concepts**, **Key Terms**, and **Essential Questions** to provide a lesson overview.
- The teacher will deliver **Introduction to Statics.ppt.**
- Students will take notes during the presentation in their journals.
- **Optional:** The teacher may want to distribute **Lesson 2.1 Key Terms Crossword** for homework once the key terms have been introduced.

Section 2 (1 hour)

- The teacher will deliver **Centroids.ppt.**
- Students will take notes during the presentation in their journals.
- The teacher will distribute, explain, and assign **Activity 2.1.1 Centroids.**
- Optional Activity - Students can complete MDSolids Animated Learning Tools – Section Properties 2.1 Centroids: Ropes and/or Section Properties 2.2 Centroids: Master of the Realm. 1-2 class periods will be needed to complete both activities.

Section 3 (1 hour)

- The teacher will review and collect Activity 2.1.1 Centroids.
- The teacher will deliver **Introduction To Structural Member Properties.ppt**
- Students will take notes during the presentation in their journals.
- Optional Activity - Students can complete MDSolids Animated Learning Tools – Section Properties 2.3 Inertia: Square One. One class period will be needed to complete the activities.
- The teacher will distribute **Activity 2.1.2 Beam Deflection.**
- Students will complete Activity 2.1.2 Beam Deflection while the teacher leads the class through the activity.
- Students will complete Activity 2.1.2 Beam Deflection calculations and conclusion questions individually for homework.

Section 4 (1 hour)

- The teacher will review and collect Activity 2.1.2 Beam Deflection.
- The teacher will deliver **Free Body Diagrams.ppt.**
- Students will take notes during the presentation in their journals.
- The teacher will distribute, explain, and assign **Activity 2.1.3 Free Body Diagrams.**

Section 5 (1 hour)

- The teacher will review and collect Activity 2.1.3 Free Body Diagrams.
- The teacher will deliver **Force Vectors.ppt.**

- Students will take notes during the presentation in their journals.
- The teacher will distribute, explain, and assign **Activity 2.1.4 Calculating Force Vectors.**

Section 6 (1 hour)

- The teacher will review and collect Activity 2.1.4 Calculating Force Vectors.
- The teacher will deliver **Moments.ppt.**
- Students will take notes during the presentation in their journals.
- The teacher will distribute **Activity 2.1.5 Calculating Moments.**
- Students will complete Activity 2.1.5 Calculating Moments while the teacher leads the class through the activity.
- Students will complete Activity 2.1.5 Calculating Moments calculations and conclusion questions individually for homework.

Section 7 (1 hour)

- The teacher will review and collect Activity 2.1.5 Calculating Moments.
- The teacher will deliver **Calculating Truss Forces.ppt.**
- Students will take notes during the presentation in their journals.
- The teacher will distribute and explain **Activity 2.1.6 Step-by-Step Truss System.**
- The teacher will begin the activity by guiding students through the activity procedure and steps.

Section 8 (1 hour)

- Students will continue to work on Activity 2.1.6 Step-by-Step Truss System.
- The teacher will review and collect Activity 2.1.6 Step-by-Step Truss System.
- The teacher will distribute and explain **Activity 2.1.7 Calculating Truss Forces.**

Section 9 (1 hour)

- The teacher will distribute **Project 2.1.8 Truss Design**, and students in teams of two or three will build trusses as outlined in the activity. Students will allow their trusses to dry before the next class session.
- Students will continue work on Activity 2.1.7 Calculating Truss Forces while the instructor provides necessary guidance.

Section 10 (1 hour)

- Students will test their truss designs and complete required documentation in their engineering journals.
- As teams take turns testing their designs, students will continue work on Activity 2.1.7 Calculating Truss Forces. The instructor will provide necessary guidance.

Section 11 (1 hour)

- The teacher will lead a discussion to define the constraints and expectations for the Truss Design Challenge portion of Project 2.1.8 Truss Design.
- Students will record the necessary information in their engineering notebooks.
- Students will begin designing and evaluating their design ideas.
- Students will complete the calculations for Activity 2.1.7 Calculating Truss Forces as homework.

Sections 12 – 14 (3 hours)

- The teacher will review and collect Project 2.1.8 Calculating Truss Forces.
- Students will finish designing, building, testing, and preparing documentation for the Truss Design Challenge portion of Project 2.1.8 Truss Design.

Comments:

Semester 1 – **Unit 2 - Material and Structures**

Competencies	Standards	Suggested Pacing	Essential Vocabulary	Resources/Materials
2C - Identifies and documents the properties of materials.	**Career Technical Education:** ***ED/PSCT/** **5.2** Understand the universal, systematic problem-solving model that incorporates input, process, outcome, and feedback components. **Core Academic:** ***ED/C/2.2W/G8** (1.6) Revise writing for word choice; appropriate organization; consistent point of view; and transitions between paragraphs, passages, and ideas.	**Lesson 2.2 -** **11 hours:** Material Properties	Additive Process Ceramic Codes Composite Decision Matrix Finishing Forming Liability Manufacturing Material Mechanical Properties Metals Physical Properties Polymers Product Life Cycle Raw Material Recycling Subtractive Synthetic	**Teacher Resources** Refer to Suggestions/ Assessments section. **Student Resources** Refer to Suggestions/ Assessments section.

Suggestions/Assessments:
Lesson 2.2

Section 1 (1 hour)

- The teacher will present **Concepts**, **Key Terms**, and **Essential Questions** to provide a lesson overview.
- The teacher will present **Introduction to Materials.ppt.**
- Students will take notes during the presentation in their journals.
- The teacher will create teams of two to four students.
- The teacher will distribute and explain **Activity 2.2.1 Product Analysis.**
- Student teams will complete the brainstorming portion of Activity 2.2.1 Product Analysis (Part 1 Steps 1 and 2).
- The teacher will remind students to bring products to the next class meeting.
- **Optional:** If you prefer to provide the students with a list of common products instead of students selecting items from home, then refer to Lesson 2.2 Teacher Notes for a sample list of products.
- **Optional:** The teacher may want to distribute **Lesson 2.2 Key Terms Crossword** for homework once the key terms have been

introduced.

Section 2 (1 hour)

- The teacher will discuss and explain Part 1, Steps 3 through 8 of Activity 2.2.1 Product Analysis.
- Student teams will complete Part 1, Steps 3 through 8 of Activity 2.2.1 Product Analysis.

Sections 3 – 4 (2 hours)

- The teacher will demonstrate the proper procedure for completing step 9 of Activity 2.2.1 Product Analysis. The teacher will utilize an example of a product component.
- Student teams will work on completing Step 9 of Activity 2.2.1 Product Analysis.
- Students will complete Step 9 of Activity 2.2.1 Product Analysis.

Section 5 (1 hour)

- The teacher will explain Part 2: Modeling of Activity 2.2.1 Product Analysis.
- Students will complete Part 2: Modeling of Activity 2.2.1 Product Analysis.
- Students will complete Activity 2.2.1 for homework, if necessary.
- The teacher will use **Drawing Rubric** to assess the modeled parts. Each team will model a total of four parts.

Section 6 (1 hour)

- The teacher will collect Activity 2.2.1 Product Analysis.
- The teacher will present **Introduction to Manufacturing Processes.ppt.**
- Students will take notes in their journals.

Section 7 (1 hour)

- The teacher will select and show students short videos relating to manufacturing processes. Video files are located within the curriculum file and can be accessed by selecting **SME Videos**
- The teacher will introduce **Activity 2.2.2 Manufacturing Processes.**
- Students will complete Activity 2.2.2 Manufacturing Processes as homework, if necessary.

Section 8 (1 hour)

- The teacher will collect Activity 2.2.2 Manufacturing Processes.
- The teacher will introduce **Activity 2.2.3 Recycling** by presenting **Recycling Materials.ppt.** Notes are included on each slide to aid with the presentation.
- Students will use **Activity 2.2.3a Recycling Facts** to document information from the teacher presentation and for Activity 2.2.3 Recycling.
- Student teams will begin Part 2 of Activity 2.2.3 Recycling. Students will finish it as homework, if necessary.

Section 9 (1 hour)

- Student teams will use the Product Development Lifecycle example provided in the Recycling Materials presentation to complete

task three of Activity 2.2.3 Recycling.

- Student teams will complete tasks three and four of Project 2.2.3 Recycling as homework, if necessary.
- **Optional Homework:** You may want to send students to the Publishers National Environment Bureau at http://www.pneb.com.au/ for a guided tour of the paper lifecycle. Select the recycling tab to locate the paper lifecycle tour.

Sections 10 – 11 (2 hours)

- The teacher will collect two Product Development Lifecycles per team and assess for completion of all steps.
- The teacher will collect Project 2.2.3a Recycling and assess using **Activity 2.2.3a Recycling Facts Answer Key.**
- Student teams will begin working on task five of Activity 2.2.3 Recycling.
- The teacher will pre-approve student team designs for task five.
- Student teams will complete task five of Activity 2.2.3 Recycling as homework, if necessary.
- The teacher will collect the Conclusion section from each student and assess for completion.
- The teacher will collect and display the sign, cartoon, song, commercial, bumper sticker, t-shirt, or packaging created per team. These items will be assessed using **Activity 2.2.3 Recycling Rubric**.

Comments:

CTE/ROP Principles of Engineering 1/2

Semester 1 – **Unit 2 - Material and Structures**				
Competencies	**Standards**	**Suggested Pacing**	**Essential Vocabulary**	**Resources/Materials**
2D - Collects, analyzes and tests samples of the four basic materials. **2E** - Describes and safely conduct destructive and non-destructive material testing and will be able to use the data collected through these tests to compute and document mechanical properties. **2F** - Uses Inspection techniques to determine failure **2G** - Analyzes a product that breaks and be able to explain how the material failed.	**Career Technical Education:** ***ED/PSCT/** **5.2** Understand the universal, systematic problem-solving model that incorporates input, process, outcome, and feedback components. **5.3** Use critical thinking skills to make informed decisions and solve problems. ***ED/TKS/** **10.6** Understand and apply the appropriate use of quality control systems and procedures. **Core Academic:** ***ED/A/1.2S/IE/G9-12/** **(1.a)** Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.	**Lesson 2.3 -** **10 hours:** Material Testing	Axial Stress Breaking Stress Compression Deformation Destructive Testing Elastic Limit Elongation Factor of Safety Failure Point Fatigue Hooke's Law Modulus of Elasticity Nondestructive Testing Problem Solving Proportional Limit Quality Control Reliability Resilience Rupture Strength Shear Stress Standard Deviation Statistics Strain Stress Stress-Strain Curve Tension Toughness Ultimate Stress Variance	**Teacher Resources** Refer to Suggestions/ Assessments section. **Student Resources** Refer to Suggestions/ Assessments section.

Suggestions/Assessments:
Lesson 2.3

Section 1 (1 hour)

- The teacher will present **Concepts**, **Key Terms**, and **Essential Questions** to provide a lesson overview.
- The teacher will present **Material Testing.ppt**.
- Students will take notes during the presentation in their journals.
- **Optional:** The teacher may distribute **Lesson 2.3 Key Terms Crossword** for homework once the key terms have been introduced.

Section 2 (1 hour)

- The teacher will finish presenting **Material Testing.ppt**.
- Students will continue to take notes in their journals.
- The teacher will distribute and provide an overview of **Activity 2.3.2 Tensile Testing**.
- The teacher will distribute **Activity 2.3.2a Machining Test Sample.**
- The teacher will demonstrate the proper lab procedures for creating a test sample, highlighting equipment and safety protocols.
- Students will take notes in their journals.

Section 3 (1 hour)

- The teacher will present **Using the Stress Analyzer for Tensile Testing.ppt**.
- Students will take notes during the presentation in their journals.
- The teacher will demonstrate Tensile Test calculations using the test data retrieved while demonstrating tensile test procedures.
- Students will fill in Activity 2.3.2 Tensile Testing with classroom demo data. Students can then use demo data as a guide in calculating their own data.

Section 4 (1 hour)

- The teacher will finish demonstrating Tensile Test calculations.
- Students will complete Activity 2.3.2 Tensile Testing with classroom demo data and calculations.
- The teacher will distribute electronic copies of Activity 2.3.2 Tensile Testing to students.
- **NOTE:** The teacher may wish to have students work in teams or as individuals to create and/or break test samples, depending on the resources available. It is recommended, however, that students individually complete Activity 2.3.2 Tensile Testing.
- Students will begin creating tensile test samples.

Section 5 (1 hour)

- The teacher will distribute **Activity 2.3.1 Engineering Calculations**.
- The teacher will distribute **Activity 2.3.1a Engineering Calculations Student Worksheet.**
- The teacher will demonstrate calculations for Activity 2.3.1 Engineering Calculations until students are comfortable enough to complete the remainder of problems individually.
- Students can complete the engineering problems using the provided Activity 2.3.1a Engineering Calculations Sheet.

- **NOTE:** There will likely be additional time for students to complete the calculations while they are waiting for machines on day 2.

Sections 6-9 (4 hours)

- Depending on classroom setup and equipment, students should create a test sample and complete Activity 2.3.2 Tensile Testing.
- During equipment downtime, students will complete Activity 2.3.1 Engineering Calculations.

Section 10 (1 hour)

- Students will complete Activity 2.3.2 Tensile Testing.
- Students will complete Activity 2.3.1 Engineering Calculations.

Comments:

Semester 1 – **Unit 2 - Material and Structures**

Competencies	Standards	Suggested Pacing	Essential Vocabulary	Resources/Materials
2H - Understands Engineering and its History. **2I** - Works in teams as problem solver. **2J**. - Is able to identity fields in Engineering **2K** - Demonstrates knowledge of Engineering Technologies	**Career Technical Education:** ***ED/TC/** **4.3** Understand the influence of current and emerging technology on selected segments of the economy ***ED/PSCT/** **5.1** Apply appropriate problem-solving strategies and critical thinking skills to work-related issues and tasks. **Core Academic:** ***ED/C/2.2W/WSA/G8/** **(1.4)** Plan and conduct multiple-step information searches by using computer networks and modems.	**Lesson 2.4 -** **5 hours:** Design Problem – Materials and Structures.	Accuracy Assembly Brainstorming Component Consensus Constraint Decision Matrix Design Brief Design Modification Design Process Design Statement Designer Open-Ended Pictorial Sketch Problem Statement Purpose Sketch Solid Modeling Target Consumer Team	**Teacher Resources** Refer to Suggestions/ Assessments section. **Student Resources** Refer to Suggestions/ Assessments section.

Suggestions/Assessments:
Lesson 2.4

Section 1 (1 hour)

- The teacher will review **Career Field Description** along with **Career Field Description Rubric**. Students will complete the activity before the end of the unit. They may work on the activity during class as time allows. Additional work must be completed outside of class.
- The teacher will present any additional **Concepts**, **Key Terms**, and **Essential Questions** to provide an overview.
- The teacher will divide the class into teams of two or three.
- The teacher will distribute and introduce **Problem 2.4.1 Design Problem** and **Design Problem Rubric**.
- **Optional:** The teacher will present **Teamwork.ppt**, if not covered in Lesson 2.4, while students take notes in their journals.
- **Optional:** The teacher will review the design process used in this course by presenting **Design Process Overview.ppt** if it was not covered in Lesson 2.4.
- Students will take notes in their journal.

- The teacher will distribute **Example Design Process**. Students will keep Example Design Process document available for reference during this lesson.
- Students will begin work on Problem 2.4.1 Design Problem.
- **Optional:** The teacher may distribute **Lesson 2.4 Key Terms Crossword** for homework once the key terms have been introduced.

Section 2 – 5 (4 hours)

- The teacher will distribute and explain the **Decision Matrix Template** and **Decision Matrix Rubric**.
- The teacher will distribute and discuss **Design Modifications Chart** and **Citations in APA Style**. Students will continue working on deliverables to be completed for Problem 2.4.1 Design Problem.
- The teacher will keep students on task and answer any questions during the process.
- Students will complete Problem 2.4.1 Design Problem.
- Students will demonstrate their solution to the class.
- The teacher will assess students using Decision Matrix Rubric and Design Problem Rubric.

Comments:

Semester 2 - **Unit B - Career Development (10 hours)**				
Competencies	**Standards**	**Suggested Pacing**	**Essential Vocabulary**	**Resources/Materials**
A - Completes an appropriate resume and job application. **B** - Acquires job interview techniques. **C** - Attains 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/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,	**A - 3 hours:** Resume and **2 hours**: Job Application **B – 2.5 hours:** Job interviews **C - 2.5 hours:** Career awareness	Career Characteristics Convicted Description Disability Extracurricular Interview skills Job Application Job Interview Labor Laws Limitations Objective Position Portfolio Previous/Former Reference Referred Resume Salary Skills Strengths	**Teacher Resources:** Job Finder's Guide Employability Skills Handbook (lesson plan examples) http://www.baldyviewrop.com/teachers_staff/lesson_plans.htm **Student Resources:** Master Application Job Finder's Guide www.snagajob.com www.monster.com http://www.ca.gov/Jobs/

	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. ***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).			

Suggestions/Assessments:

Resume/Job Application/Letters

- Have students start by writing a Personal Statement (See Job Finder's Guide)
- Have students properly request a job application in person, and/or print one from the Internet. Students should fill out and complete the application. Also have students complete an online job application for a company.
- Use technology to show students exemplary and poor-quality examples of resumes, cover letters, and follow-up letters. Identify the components of business letters and a resume. Have students identify errors in the examples.
- Show Resume PowerPoint presentation and have students fill out a Resume Worksheet with all the information they will need to type in their Resume in order to best prepare and complete the Resume Document.
- Have students prepare a Cover Letter Document, References Document, and Thank you letter Document.

Job Interviews

- Have students type up responses to interview questions. Have students practice with a partner, then present in front of the class.
- Have students participate in mock interviews.

Career Awareness

- Have students visit selected college and university Web sites to discover what courses are taught and what majors are offered in the field of information technology.
- Have students share their findings with the class using electronic presentation software.
- Have students use the online *Occupational Outlook Handbook* (http://www.bls.gov/oco/) to select an area of occupational interest. Have them research salary and educational requirements for the chosen career and then prepare a one-page summary of the information using word processing software or do a multimedia presentation using presentation software, such as Microsoft PowerPoint.
- Have students understand:
  - Keeping informed of the job market will ensure that you have every opportunity to obtain the best jobs available.
  - Well-prepared job candidates perform much better in the job application and interview process and are more likely to be hired for desirable positions.

- Have students conduct a job search.
- Guest Speakers: College representatives, Professional in the Industry

- The teacher will assess the Resume, Cover Letter, References Page and Thank you letter documents, and mock interviews.

Comments:

- At the beginning of the unit, use the **KWL Chart** to determine what students Know and what they Want to know about careers and emerging technologies in the industry. At the end of the unit, use K-W-L to review by having students recall what they have learned.

Semester 2 – **Unit 3 – Control Systems**				
Competencies	**Standards**	**Suggested Pacing**	**Essential Vocabulary**	**Resources/Materials**
3I - Creates and present a flow diagram of a functional hydraulic system. **3J** - Calculates pressures on components. **3K** - Constructs a functional pneumatic system using a trainer. **3L** - Uses calculation to determine pressure and forces on the system.	**Career Technical Education:** ***ED/ETP/** **D1.5** Prepare reports and data sheets for writing specifications **D8.1** Understand how to design systems that use computer programs to interact with hardware. **D9.3** Program a computing device to control an automated system or process. **Core Academic:** ***ED/A/1.2S/IE/G9-12/** **(1.I)** Analyze situations and solve problems that require combining and applying concepts from more than one area of science.	**Lesson 3.2 -** **15 hours:** Fluid Power	Absolute Pressure Atmospheric Pressure Boyle's Law Charles' Law Check Valve Compressor Crank Cylinder Directional-Control Valve Double-Acting Cylinder Filter Flow Meter Flow Rate Flow Velocity Flow-Control Valve Fluid Power Gay-Lussac's Law Hydraulics Lubricator Pascal's Law Piston Pneumatics Pressure Pressure Regulator Pressure Relief Valve Pump Receiver Tank Reservoir Single-Acting Cylinder Solenoid Transmission Lines Valve Viscosity Volume	**Teacher Resources** Refer to Suggestions/ Assessments section. **Student Resources** Refer to Suggestions/ Assessments section.

Suggestions/Assessments:
Lesson 3.2

Section 1 (1 hour)

- The teacher will present Concepts, Key Terms, and Essential Questions to provide a lesson overview.
- The teacher will deliver Fluid Power Introduction.ppt.
- Students will take notes during the presentation in their journals.
- Optional: The teacher may distribute Lesson 3.2 Key Terms Crossword for homework once the key terms have been introduced.

Section 2 (1 hour)

- The teacher will distribute and assign **Activity 3.2.1 Fluid Power Applications** and show **Fluid Power Applications Exemplar.ppt**.
- The teacher will distribute and explain the **Activity 3.2.1 Fluid Power Applications Rubric.**
- Students will work in teams to complete Activity 3.2.1 Fluid Power Applications for the duration of the lesson and will deliver their presentations at the conclusion of the lesson. Conclusion questions should be completed individually.

Section 3 (1 hour)

- The teacher will present **Pneumatic Power.ppt**.
- Students will take notes during the presentation in their journals.
- The teacher will reveal the sample pneumatic device to students.
- Students will work on **Activity 3.2.2 Pneumatic Demonstration** to gather information about the sample pneumatic device.
- The teacher will demonstrate the pneumatic device to students and moderate a student-led discussion of how the device functions and relates to the primary parts of a common pneumatic device.

Sections 4-7 (4 hours)

- Students will complete Activity 3.2.2 Pneumatic Demonstration
- The teacher will distribute and explain **Project 3.2.3 Pneumatic Brake Design** and **Project 3.2.3 Pneumatic Brake Design Rubric**.
- The teacher will utilize the **fischertechnik® Pneumatic Components** document to explain the role and capabilities of the components to be used to complete Project 3.2.3 Pneumatic Brake Design.
- Students will work in teams to plan a solution and complete Project 3.2.3 Pneumatic Brake Design.
- Students will individually complete Project 3.2.3 Pneumatic Brake Design procedure and conclusion questions.
- Students will demonstrate their solutions to Project 3.2.3 Pneumatic Brake Design.

Section 8 (1 hour)

- The teacher will present **Hydraulic Power.ppt**.
- Students will take notes during the presentation in their journals.
- The teacher will reveal the sample hydraulic device to students.
- Students will complete the **Activity 3.2.4 Hydraulic Demonstration** to gather information about the sample hydraulic device.

- The teacher will demonstrate the hydraulic device to students and moderate a student-led discussion of how the device functions and relates to the primary parts of a common hydraulic device.
- Students will be assigned **Fluid Power Practice Problems**.

Section 9 (1 hour)

- The teacher will distribute and explain **Project 3.2.5 Hydraulic Lift Design** and **Project 3.2.5 Hydraulic Lift Design Rubric**.
- The teacher will give a brief introduction of the hydraulics components that will be used to complete Project 3.2.5 Hydraulic Lift Design.
- Student teams will plan a solution to Project 3.2.5 Hydraulic Lift Design.

Section 10-14 (5 hour)

- Student teams will complete Project 3.2.5 Hydraulic Lift Design.
- Students will individually complete Project 3.2.5 Hydraulic Lift Design procedure and conclusion questions.
- The teacher will review and collect Fluid Power Practice Problems to assess student competence.
- Students will demonstrate their solutions to Project 3.2.5 Hydraulic Lift Design.

Section 15 (1 hour)

- Students will present their Activity 3.2.1 Fluid Power Applications presentations to the class and submit deliverables associated with the activity.

Comments:

Semester 2 – **Unit 3 – Control Systems**

Competencies	Standards	Suggested Pacing	Essential Vocabulary	Resources/Materials
3M - Understands the Product Development Lifecycle Chart **3N** - States problem clearly **3O** - Designs Brief to problem. **3P** - Examines evolution of an invention. **3Q** - Uses simple techniques model problem. **3R** - Tests problem with appropriate methods. **3S** - Clearly presents solution to a group	**Career Technical Education:** ***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 attainment of goals. ***ED/ETP/** **C2.2** Apply conventional engineering design processes and procedures accurately, appropriately, and safely **D8.1** Understand how to design systems that use computer programs to interact with hardware. **D8.4** Know the function and interaction of basic computer components and peripherals.	**Lesson 3.3 –** **15 hours:** Design Problem – Control Systems	Accuracy Assembly Brainstorming Component Consensus Constraint Decision Matrix Design Brief Design Modification Design Process Design Statement Designer Open-Ended Pictorial Sketch Problem Statement Purpose Sketch Solid Modeling Target Consumer Team	**Teacher Resources** Refer to Suggestions/ Assessments section. **Student Resources** Refer to Suggestions/ Assessments section.

Suggestions/Assessments:
Lesson 3.3

Section 1 – 2 (2 hours)

- The teacher will review **Career Demand, Salary, and Education** along with **Career Demand, Salary, and Education Rubric**. Students will complete the activity before the end of the unit. They may work on the activity during class as time allows. Additional work must be completed outside of class.
- The teacher will present **Concepts**, **Key Terms**, and **Essential Questions** to provide a lesson overview.
- The teacher will divide the class into teams of two or three.
- The teacher will distribute and introduce **Problem 3.3.1 Design Problem** and **Design Problem Rubric**.
- The teacher will review the design process used in this course by presenting **Design Process Overview.ppt.**
- Students will take notes during the presentation in their journals.
- **Optional:** The teacher may want to distribute **Lesson 3.3 Key Terms Crossword** for homework once the key terms have been

introduced.

Section 3 – 15 (13 hours)

- The teacher will distribute and explain the **Decision Matrix Template**.
- The teacher will distribute and discuss **Design Modifications Chart** and **Citations in APA Style**.
- Students will continue working on deliverables to be completed for Problem 3.3.1 Design Problem.
- The teacher will keep students on task and answer any questions during the process.
- Students will complete Problem 3.3.1 Design Problem.
- Students will demonstrate their solution to the class.
- The teacher will assess students using Decision Matrix Rubric and Design Problem Rubric.

Comments:

Semester 2 – **Unit 4 – Statics and Kinematics (30 hours)**

Competencies	Standards	Suggested Pacing	Essential Vocabulary	Resources/Materials
4A - Presents statistical analysis of measurements that can help to verify the quality of a design or process. **4B** - Uses graphics to communicate patterns in recorded data.	**Career Technical Education:** ***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. **Core Academic:** ***IE/C/2.2W/WSA/G11-12** **(1.8)** Integrate databases, graphics, and spreadsheets into word-processed documents.	**Lesson 4.1 –** **5 hours:** Statistics	Accuracy Data Deviation Experiment Event Frequency Distribution Mean Mean Deviation Median Mode Normal Distribution Probability Process Control Quality Assurance Reliability Sample Space Standard Deviation Statistical Process Control Tolerance Variance	**Teacher Resources** Refer to Suggestions/ Assessments section. **Student Resources** Refer to Suggestions/ Assessments section.

Suggestions/Assessments:
Lesson 4.1

Section 1 (1 hour)

- The teacher will distribute and explain activity Career Reflection, Abstract, and Presentation to students and assign a due date.
- The teacher will present **Concepts**, **Key Terms**, and **Essential Questions** to provide a lesson overview.
- The teacher will present **Probability.ppt**.
- Students will take notes during the presentation in their journals.

Section 2 (1 hour)

- The teacher will present **Statisitics.ppt.**
- Students will take notes during the presentation in their journals.

Section 3 (1 hour)

- The teacher will distribute and explain **Activity 4.1.1 Statistical Data.**
- The teacher will assign students to groups of two.
- Students groups will begin working on Activity 4.1.1 Statistical Data.

Section 4 (1 hour)

- Students will complete Activity 4.1.1 Statistical Data.
- The teacher will collect Activity 4.1.1 Statistical Data.

Section 5 (1 hour)

- The teacher will distribute and explain **Activity 4.1.2 Candy Statistics.**
- Students will work individually to complete Activity 4.1.2 Candy Statistics.
- The teacher will collect Activity 4.1.2 Candy Statistics.

Comments:

Semester 2 – **Unit 4 – Statistics and Kinematics**

Competencies	Standards	Suggested Pacing	Essential Vocabulary	Resources/Materials
4C - Explains the difference between distance traveled and displacement. **4D** - Designs and builds a device for the purpose of conducting experiments of acceleration, displacements and velocity. **4E** - Calculates range and initial acceleration from data they record from experiments.	**Career Technical Education:** ***ED/PSCT/** **5.3** Use critical thinking skills to make informed decisions and solve problems. ***ED/TKS/** **10.2** Understand the importance of technical and computer-aided technologies essential to the language of the Engineering and Design sector. ***ED/EDP/** **C2.2** Apply conventional engineering design processes and procedures accurately, appropriately, and safely. **Core Academic:** ***IE/C/2.2W/WSA/G11-12** **(1.8)** Integrate databases, graphics, and spreadsheets into word-processed documents.	**Lesson 4.2 –** **10 hours:** Kinematics	Free Fall Distance Displacement Velocity Speed Acceleration	**Teacher Resources** Refer to Suggestions/ Assessments section. **Student Resources** Refer to Suggestions/ Assessments section.

Suggestions/Assessments:
Lesson 4.2

Section 1 (1 hour)

- The teacher will present **Concepts**, **Key Terms**, and **Essential Questions** to provide a lesson overview.
- The teacher will distribute and explain **Project 4.2.1 Self-Propelled Vehicle Design.**
- In teams of two or three, students will begin designing their solutions for Project 4.2.1 Self-Propelled Vehicle Design.
- **Optional:** The teacher may want to distribute **Lesson 4.2 Key Terms Crossword** for homework once the key terms have been introduced.

Sections 2 – 7 (6 hours)

- Students will build, design, and test their solutions for Project 4.2.1 Self-Propelled Vehicle Design.
- Students should individually answer Project 4.2.1 Self-Propelled Vehicle Design conclusion questions after completing the activity.
- Note: While students are completing Project 4.2.1 Self-Propelled Vehicle Design, you may wish to begin building or have other

students begin building the devices for **Activity 4.2.2 Acceleration Due to Gravity** using **Activity 4.2.2a Building the Acceleration Device**.

Section 8 (1 hour)

- The teacher will collect the documentation for Project 4.2.1 Self-Propelled Vehicle Design.
- The teacher will distribute and explain Activity 4.2.2 Acceleration Due to Gravity.
- Students in teams of two to three will complete Activity 4.2.2 Acceleration Due to Gravity and then individually complete the conclusion questions.

Section 9 (1 hour)

- The teacher will review and collect Activity 4.2.2 Acceleration Due to Gravity.
- The teacher will deliver **Projectile Motion.ppt**.
- Students will take notes during the presentation in their journals.

Section 10 (1 hour)

- The teacher will distribute, explain, and assign **Activity 4.2.3 Projectile Motion.**
- Students will individually complete Activity 4.2.3 Projectile Motion.

Comments:

Semester 2 – **Unit 4 – Statistics and Kinematics**

Competencies	Standards	Suggested Pacing	Essential Vocabulary	Resources/Materials
4F - Uses proper sketching techniques. **4G** - Produces a technical report on an Engineering Field. **4H** - Records all course work in Engineers Notebook. **4I** - Presents information in report form. **4J** - Tables, charts and graphs will be used to present complex information.	**Career Technical Education:** ***ED/PSCT/** **5.1** Apply appropriate problem-solving strategies and critical thinking skills to work-related issues and tasks. ***ED/TKS/** **10.2** Understand the importance of technical and computer-aided technologies essential to the language of the Engineering and Design sector. ***ED/EDP/** **C4.5** Apply pictorial drawings derived from orthographic multi-view drawings and sketches and from a solid modeler. **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.	**Lesson 4.3 –** **15 hours:** Design Problem – Statistics and Kinematics	Accuracy Assembly Brainstorming Component Consensus Constraint Decision Matrix Design Brief Design Modification Design Process Design Statement Designer Open-Ended Pictorial Sketch Problem Statement Purpose Sketch Solid Modeling Target Consumer Team	**Teacher Resources** Refer to Suggestions/ Assessments section. **Student Resources** Refer to Suggestions/ Assessments section.

Suggestions/Assessments:
Lesson 4.3

Section 1 – 2 (2 hours)

- The teacher will present any additional **Concepts**, **Key Terms**, and **Essential Questions** not covered in previous design lessons to provide an overview.
- The teacher will distribute, explain, and assign **Career Reflection, Abstract, and Presentation** along with **Career Reflection, Abstract, and Presentation Rubric**. Students will complete the activity before the end of the unit. They may work on the activity during class as time allows. Additional work must be completed outside of class.
- The teacher will divide the class into teams of two or three.
- The teacher will distribute and introduce **Problem 4.3.1 Design Problem** and **Design Problem Rubric**.
- Students will use the Example Design Process document they received earlier in the year for reference during this lesson.

- Students will begin work on Problem 4.3.1 Design Problem

Section 3 – 15 (13 hours)

- The teacher will distribute and explain the **Decision Matrix Template** and **Decision Matrix Rubric**.
- The teacher will distribute and discuss **Design Modifications Chart**, and **Citations in APA Style**.
- Students will continue working on deliverables to be completed for Problem 4.3.1 Design Problem.
- The teacher will keep students on task and answer any questions during the process.
- Students will complete Problem 4.3.1 Design Problem.
- Students will demonstrate their solution to the class.
- The teacher will assess students using Decision Matrix Rubric and Design Problem Rubric.

Comments: