Davison Community Schools
ADVISORY CURRICULUM COUNCIL
I/II 21MAR14

Introduction to Engineering (IED)

Course Essential Questions (from Phase I report):

1. How does the design process promote the development of good solutions to technical problems?
2. How can an engineer or technical professional effectively communicate ideas and solutions in a global community?
3. How do inventors and innovators impact and shape society?

Phase II Curriculum

Unit 1: Design Process

Essential Questions:	**Essential Understanding:**
1. How might we create the best possible solution to a problem? 2. What is the most effective way to generate potential solutions to a problem? 3. What are the most pressing engineering/technical problems of our time? 4. What is an engineer?	1. An engineering design process involves a characteristic set of practices and steps. 2. Research derived from a variety of sources (including subject matter experts) is used to facilitate effective development and evaluation of a design problem and a successful solution to the problem. 3. A problem and the requirements for a successful solution to the problem should be clearly communicated and justified. 4. Brainstorming may take many forms and is used to generate a large number of innovative, creative ideas in a short time. 5. A solution path is selected and justified by evaluating and comparing competing design solutions based on jointly developed and agreed-upon design criteria and constraints. 6. Physical models are created to represent and evaluate possible solutions using prototyping technique(s) chosen based on the presentation and/or testing requirements of a potential solution. 7. Problem solutions are optimized through evaluation and reflection and should be clearly communicated. 8. The scientific method guides the testing and evaluation of prototypes of a problem solution 9. Geometric shapes and forms are described and differentiated by their characteristic features. 10. Hand sketching of multiple representations to fully and accurately detail simple objects or parts of objects is a technique used to convey visual and technical information about an object. 11. Technical professionals clearly and accurately document and report their work using technical writing practice in multiple forms. 12. Specific oral communication techniques are used to effectively convey information and communicate with an audience

	13. Sketches, drawings, and images are used to record and convey specific types of information depending upon the audience and the purpose of the communication. 14. Engineering has a global impact on society and the environment. 15. Engineering consists of a variety of specialist sub-fields, with each contributing in different ways to the design and development of solutions to different types of problems. 16. In order to be an effective team member, one must demonstrate positive team behaviors and act according to accepted norms, contribute to group goals according to assigned roles, and use appropriate conflict resolution strategies.

Curriculum Standards

IV – Information Technology Applications
- E - Select and use different forms of communications technology including word processing, spreadsheets, database, presentation software, email to communicate, and use of the internet to search for and display information.
- 2 - Read and create basic computer aided engineering drawings.

IX – Employability and Career Development
- A – Know and understand the importance of employability skills.
- 1 – Identify and demonstrate positive work behaviors and personal qualities needed to be employable.

X – Technical Skills
- D – Preparing to Draw: Basic Dimensioning and Dimensioning Skills
- 5 – Identify and create line types.
- 6 – Identify and create sketches

Knowledge/Content Students will know about….	**Skills/Processes** Students will be able to……
1. Following a detailed design process will yield the best possible solution to a problem. 2. Brainstorming is the best effective way to generate potential solutions to a problem. 3. You should generate multiple alternate solutions, so that you can narrow your efforts down to one or two solution paths. 4. Hydrogen fuel cells, electric vehicles, health technologies, and wind harvesting are some of the most pressing engineering/technical problems of our time. 5. An engineer is a person who is trained in and uses technological and scientific knowledge to solve practical problems. 6. Engineers research, develop, design, supervise, and manage in the fields of: chemical, electrical, mechanical, civil, aeronautical, aerospace and astrological, agricultural, architectural, automotive, biomedical, computer, industrial, and manufacturing engineering.	1. Identify and define the terminology used in engineering design and development. 2. Identify the steps in an engineering design process and summarize the activities involved in each step of the process. 3. Complete a design project utilizing all steps of a design process, and find a solution that meets specific design requirements. 4. Utilize research tools and resources (such as the Internet; media centers; market research; professional journals; printed, electronic, and multimedia resources; etc.) to gather and interpret information to develop an effective design brief. 5. Define and justify a design problem, and express the concerns, needs, and desires of the primary stakeholders. 6. Present and justify design specifications, and clearly explain the criteria and constraints associated with a successful design solution. 7. Write a design brief to communicate the problem, problem constraints, and solution criteria. 8. Generate and document multiple ideas or solution paths to a problem through brainstorming. 9. Clearly justify and validate a selected solution path. 10. Construct a testable prototype of a problem solution.

	11. Describe the design process used in the solution of a particular problem and reflect on all steps of the design process. 12. Justify and validate a problem solution. 13. Analyze the performance of a design during testing and judge the solution as viable or non-viable with respect to meeting the design requirements. 14. Explain the concept of proportion and how it relates to freehand sketching. 15. Generate non-technical concept sketches to represent objects or convey design ideas. 16. Utilize an engineering notebook to clearly and accurately document the design process according to accepted standards and protocols to prove the origin and chronology of a design. 17. Deliver organized oral presentations of work tailored to the audience. 18. Create drawings or diagrams as representations of objects, ideas, events, or systems. 19. Select and utilize technology (software and hardware) to create high impact visual aids. 20. Use presentation software effectively to support oral presentations. 21. Define and differentiate invention and innovation. 22. Assess the development of an engineered product and discuss its impact on society and the environment. 23. Identify and discuss a Grand Challenge for Engineering (as identified by the National Academy of Engineering) and its potential impact on society and the environment. 24. Identify and differentiate between mechanical, electrical, civil, and chemical engineering fields. 25. Describe the contributions of engineers from different engineering fields in the design and development of a product, system, or technology. 26. Demonstrate positive team behaviors and contribute to a positive team dynamic.
Unit 2: Technical Sketching and Drawing	
Essential Questions: 1. How can we clearly convey the intent of a design to someone unfamiliar with the original problem or the solution? 2. How is technical drawing similar to and different from artistic drawing? 3. What can cause a technical drawing to be inadequate or misinterpreted?	**Essential Understanding:** 1. Brainstorming may take many forms and is used to generate a large number of innovative, creative ideas in a short time. 2. Two- and three-dimensional objects share visual relationships which allow interpretation of one perspective from the other. 3. Geometric shapes and forms are described and differentiated by their characteristic features 4. The style of the engineering graphics and the type of drawing views used to detail an object vary depending upon the intended use of the graphic. 5. Technical drawings convey information according to an established set of drawing practices which allow for detailed and universal interpretation of the drawing. 6. Hand sketching of multiple representations to fully and accurately detail simple objects or parts of objects is a technique used to convey visual and technical information about an object. 7. Sketches, drawings, and images are used to record

	and convey specific types of information depending upon the audience and the purpose of the communication.

Curriculum Standards

IX – Employability and Career Development
- A – Know and understand the importance of employability skills.
  - 1 – Identify and demonstrate positive work behaviors and personal qualities needed to be employable.

X – Technical Skills
- D – Preparing to Draw: Basic Dimensioning and Dimensioning Skills
  - 2 – Identify drawing views and details.
  - 5 – Identify and create line types.
  - 6 – Identify and create sketches
- G – Geometric Construction
  - 1 – Draw lines and curved elements.
- I – Multiview Drawings
  - 1 – Demonstrate knowledge of multiview drawings.
  - 2 – Multiview projection (third and first angle).
  - 3 – Differentiate between major surface types (normal, inclined, oblique, cylindrical).
  - 4 – Identify common part features (fillets, rounds, draft angles, chamfers).

Knowledge/Content Students will know about….	**Skills/Processes** Students will be able to……
1. We can use hand sketches to clearly convey the intent of a design to someone unfamiliar with the original with the original problem or the solution. 2. Technical drawings are made to reflect true size and shape of an object where one face of an object is presented in each view, and shows information necessary to have the part manufactured. Pictorial drawings are made to quickly communicate ideas to both technical and non-technical people, where three faces of an object are presented in one view, showing the object in a realistic view. 3. Technical drawings can be inadequate or misinterpreted if there is any information (dimensions/notes) that is omitted, disallowing the part/object to be manufactured.	1. Generate and document multiple ideas or solution paths to a problem through brainstorming. 2. Identify flat patterns (nets) that fold into geometric solid forms. 3. Explain the concept of proportion and how it relates to freehand sketching. 4. Identify and define technical drawing representations including isometric, orthographic projection, oblique, perspective, auxiliary, and section views. 5. Identify the proper use of each technical drawing representation including isometric, orthographic projection, oblique, perspective, auxiliary, and section views. 6. Identify line types (including construction lines, object lines, hidden lines, cutting plane lines, section lines, and center lines) used on a technical drawing per ANSI Line Conventions and Lettering Y14.2M-2008 and explain the purpose of each line. 7. Determine the minimum number and types of views necessary to fully detail a part. 8. Apply tonal shading to enhance the appearance of a pictorial sketch and create a more realistic appearance of a sketched object. 9. Hand sketch 1-point and 2-point perspective pictorial views of a simple object or part given the object, a detailed verbal description or the object, a pictorial view of the object, and/or a set of orthographic projections. 10. Hand sketch orthographic projections at a given scale and in the correct orientation to fully detail an object or part using the actual object, a detailed

	verbal description of the object, or a pictorial an isometric view of the object. 11. Create drawings or diagrams as representations of objects, ideas, events, or systems.
Unit 3: Measurement and Statistics	
Essential Questions: 1. How can statistical data and analysis be used to inform, justify, and validate a design or process? 2. If error is unavoidable in measurement, how can we indicate our confidence in the precision of a measurement we make? 3. What is dimensional analysis and how can it help solve problems involving quantities? 4. Why do engineers generally adhere to a set of dimensioning standards and guidelines?	**Essential Understanding:** 1. An engineering design process involves a characteristic set of practices and steps. 2. Brainstorming may take many forms and is used to generate a large number of innovative, creative ideas in a short time. 3. Physical models are created to represent and evaluate possible solutions using prototyping technique(s) chosen based on the presentation and/or testing requirements of a potential solution. 4. Problem solutions are optimized through evaluation and reflection and should be clearly communicated. 5. The scientific method guides the testing and evaluation of prototypes of a problem solution. 6. Statistical analysis of uni-variate data facilitates understanding and interpretation of numerical data and can be used to inform, justify, and validate a design or process. 7. Spreadsheet programs can be used to store, manipulate, represent, and analyze data. 8. Units and quantitative reasoning can guide mathematical manipulation and the solution of problems involving quantities. 9. Error is unavoidable when measuring physical properties, and a measurement is characterized by the precision and accuracy of the measurement. 10. The style of the engineering graphics and the type of drawing views used to detail an object vary depending upon the intended use of the graphic. 11. Technical drawings convey information according to an established set of drawing practices which allow for detailed and universal interpretation of the drawing. 12. Dimensions, specific notes (such as hole and thread notes), and general notes (such as general tolerances) are included on technical drawings according to accepted practice and an established set of standards so as to convey size and location information about detailed parts, their features, and their configuration in assemblies. 13. Hand sketching of multiple representations to fully and accurately detail simple objects or parts of objects is a technique used to convey visual and technical information about an object. 14. Technical professionals clearly and accurately document and report their work using technical writing practice in multiple forms. 15. Sketches, drawings, and images are used to record and convey specific types of information

	depending upon the audience and the purpose of the communication. 16. In order to be an effective team member, one must demonstrate positive team behaviors and act according to accepted norms, contribute to group goals according to assigned roles, and use appropriate conflict resolution strategies.

Curriculum Standards

I – Academic Foundations
- B – Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career.
  - 1 – Identify whole numbers, decimals, and fractions.
  - 2 – Demonstrate knowledge of basic arithmetic operations such as addition, subtraction, multiplication, and division.
  - 3 – Demonstrate use of rational expressions such as equal to, not equal, greater than, less than, etc.
  - 4 – Apply data and measurements to solve problems.
  - 5 – Analyze mathematical problem statements for missing and/or irrelevant data.
  - 6 – Construct charts/tables/graphs from functions and data.
  - 7 – Analyze data when interpreting operational documents.

III – Problem-Solving and Critical Thinking
- B – Use mathematics, science, and technology concepts and processes to solve problems in projects involving design and/or production.
  - 2 – Develop the active use of information technology applications.
  - 3 – Use computer applications to solve problems by creating and using algorithms through simulation and modeling techniques.

IV – Information Technology Applications
- B – Employ technological tools to expedite workflow
  - 13 – Create a spreadsheet
  - 14 – Perform calculations and analyses on data using a spreadsheet.
- D – Evaluate and use skills relating to the differing technological tools used to manipulate, report, or operate with data acquisition.
  - 4 – Apply statistical tools that verify the reliability or validity of the data used or collected in the plan, project, process, or problem.

VII – Leadership and teamwork
- A – Use leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.
  - 3 – Employ teamwork skills to achieve collective goals and use team members' talents effectively.
  - 4 – Establish and maintain effective working relationships with all levels of personnel and other departments in order to accomplish objectives and tasks..

IX – Employability and Career Development
- A – Know and understand the importance of employability skills.
  - 1 – Identify and demonstrate positive work behaviors and personal qualities needed to be employable.

X – Technical Skills
- C – Apply concepts and processes for the application of technology to engineering
  - 5 – Use and calibrate probes, sensors, measuring systems, and devices to collect data using traceable standards.
  - 6 – Explain the impact of error in measurement, predict the effect of error propagation in calculations, and record data with the correct number of significant digits.
- E – Applied mathematics
  - 1 – Demonstrate knowledge of mathematical operations.
- F – Identify Measurements
  - 1 – Identify and read precision measurement tools.
  - 2 – Calculate unit conversion.

XI – Engineering Technology Pathway
- A – Know the elements of the processes and concepts for understanding the design process.
  - 2 – Explain the elements and steps of the design process and tools or techniques that can be used for each step.

3 – Describe design constraints, criteria, and trade-offs in regard to a variety of conditions (e.g. technology, cost, safety, society, the environment, time, human resources, manufacturability).

Knowledge/Content Students will know about….	**Skills/Processes** Students will be able to……
1. Statistical data and analysis can be used to rate designs against each other. 2. We can indicate our confidence in the precision of a measurement by using the most precision measuring device available to us, utilizing significant figures, and performing statistical analysis of our measurements. 3. Dimensional analysis is the analysis of the relationships between different physical quantities by identifying their dimensions. Any number or expression can be multiplied by a factor of one without changing its value, but allows for conversion between specific units. 4. Engineers adhere to a set of dimensioning standards and guidelines because it is standardization that allows many people to work individually on parts that come together to form a finished product or system. Without standards, manufactured parts would not be interchangeable and mass production could not exist. Standardization also allows global communication.	1. Identify and define the terminology used in engineering design and development. 2. Identify the steps in an engineering design process and summarize the activities involved in each step of the process. 3. Complete a design project utilizing all steps of a design process and find a solution that meets specific design requirements. 4. Generate and document multiple ideas or solution paths to a problem through brainstorming. 5. Construct a testable prototype of a problem solution. 6. Describe the design process used in the solution of a particular problem and reflect on all steps of the design process. 7. Analyze the performance of a design during testing and judge the solution as viable or non-viable with respect to meeting the design requirements. 8. Calculate statistics related to central tendency including mean, median, and mode. 9. Represent data with plots on the real number line (e.g., dot plots, histograms, and box plots). 10. Use statistics to quantify information, support design decisions, and justify problem solutions. 11. Calculate statistics related to variation of data including (sample and population) standard deviation and range. 12. Distinguish between sample statistics and population statistics and know appropriate applications of each. 13. Use the Empirical Rule to interpret data and identify ranges of data that include 68 percent of the data, 95 percent of the data and 99.7 percent of the data. 14. Use a spreadsheet program to store and manipulate raw data. 15. Use a spreadsheet program to perform calculations using formulas. 16. Use a spreadsheet program to create and display a histogram to represent a set of data. 17. Use function tools within a spreadsheet program to calculate statistics for a set of data including mean, median, mode, quartiles, range and standard deviation. 18. Use units to guide the solution to multi-step problems through dimensional analysis and choose and interpret units consistently in formulas. 19. Choose a level of precision and accuracy appropriate to limitations on measurement when reporting quantities. 20. Convert quantities between units in the SI and the US Customary measurement systems. 21. Define accuracy and precision in measurement. 22. Measure linear distances (including length, inside diameter, and hole depth) with accuracy using a

	scale, ruler, or dial caliper and report the measurement using an appropriate level of precision. 23. Identify and define technical drawing representations including isometric, orthographic projection, oblique, perspective, auxiliary, and section views. 24. Determine the minimum number and types of views necessary to fully detail a part. 25. Dimension orthographic projections and section views of simple objects or parts according to a set of dimensioning standards and accepted practices. 26. Identify and correctly apply chain dimensioning or datum dimensioning methods to a technical drawing. 27. Identify and correct errors and omissions in the dimensions applied in a technical drawing based on accepted practice and a set of dimensioning rules. 28. Hand sketch isometric views of a simple object or part at a given scale using the actual object, a detailed verbal description of the object, a pictorial view of the object, or a set of orthographic projections. 29. Generate non-technical concept sketches to represent objects or convey design ideas. 30. Utilize an engineering notebook to clearly and accurately document the design process according to accepted standards and protocols to prove the origin and chronology of a design. 31. Create drawings or diagrams as representations of objects, ideas, events, or systems. 32. Demonstrate positive team behaviors and contribute to a positive team dynamic.
Unit 4: Modeling Skills	
Essential Questions: 1. What is the role of models in the design process? 2. How can we use technology to make the design and manufacture of a product more efficient and less prone to error? 3. What is the purpose of a portfolio?	**Essential Understanding:** 1. An engineering design process involves a characteristic set of practices and steps. 2. Brainstorming may take many forms and is used to generate a large number of innovative, creative ideas in a short time 3. A solution path is selected and justified by evaluating and comparing competing design solutions based on jointly developed and agreed-upon design criteria and constraints. 4. Physical models are created to represent and evaluate possible solutions using prototyping technique(s) chosen based on the presentation and/or testing requirements of a potential solution. 5. Problem solutions are optimized through evaluation and reflection and should be clearly communicated. 6. The scientific method guides the testing and evaluation of prototypes of a problem solution. 7. Statistical analysis of uni-variate data facilitates understanding and interpretation of numerical data and can be used to inform, justify, and validate a design or process. 8. An equation is a statement of equality between two quantities that can be used to describe real phenomenon and solve problems.

	9. Solving mathematical equations and inequalities involves a logical process of reasoning and can be accomplished using a variety of strategies and technological tools. 10. Functions describe a special relationship between two sets of data and can be used to represent real world relationships and to solve problems. 11. Technical drawings convey information according to an established set of drawing practices which allow for detailed and universal interpretation of the drawing. 12. Dimensions, specific notes (such as hole and thread notes), and general notes (such as general tolerances) are included on technical drawings according to accepted practice and an established set of standards so as to convey size and location information about detailed parts, their features, and their configuration in assemblies. 13. Hand sketching of multiple representations to fully and accurately detail simple objects or parts of objects is a technique used to convey visual and technical information about an object. 14. Computer aided drafting and design (CAD) software packages facilitate virtual modeling of parts and assemblies and the creation of technical drawings. They are used to efficiently and accurately detail parts and assemblies according to standard engineering practice. 15. Technical professionals clearly and accurately document and report their work using technical writing practice in multiple forms. 16. Sketches, drawings, and images are used to record and convey specific types of information depending upon the audience and the purpose of the communication.

Curriculum Standards

III – Problem Solving and Critical Thinking
- B – Use mathematics, science, and technology concepts and processes to solve problems in projects involving design and/or production.
  - 3 – Use computer applications to solve problems by creating ans using algorithms, and through simulation and modeling techniques.

IV – Information Technology Applications
- E – Select and use different forms of communications technology including word processing, spreadsheets, database, presentation software, email to communicate, and use of the internet to search for and display information.
  - 2 – Read and create basic computer aided engineering drawings.

IX – Employability and Career Development
- A – Know and understand the importance of employability skills.
  - 1 – Identify and demonstrate positive work behaviors and personal qualities needed to be employable.

X – Technical Skills
- D – Preparing to Draw: Basic Drawing and Dimensioning Skills
  - 5 – Identify and create line types.
  - 6 – Identify and create sketches.
- H – Engineering Drawings
  - 2 – Identify abbreviations and symbols.
- I – Multiview Drawings
  - 1 – Demonstrate knowledge of multiview drawings.
  - 2 – Multiview projection (third and first angle).
  - 3 – Differentiate between major surface types (normal, inclined, oblique, cylindrical).
  - 4 – Identify different part features (fillets, rounds, draft angles, chamfers).

J – Section Views
1 – Identify and construct section views.
2 – Identify ANSI material symbols.
3 – Apply section rules.

K – Auxiliary Views
1 – Identify and construct auxiliary views.
2 – Draw true view, true length lines, and true angles.

L – Dimensioning Skills
1 – Locate and describe features.
4 – Demonstrate knowledge of tolerances.
5 – Identify and label common mechanical feature notations.
6 – Place local and general notes including fonts, lettering size, style, etc.
8 – Identify measurements.

Knowledge/Content Students will know about….	**Skills/Processes** Students will be able to……
1. Three dimensional computer models allow designers to virtually create, manipulate, and test products and systems prior to building and testing physical models. Physical models allow hands on manipulation and testing of a product or system in its intended operating environment. 2. Computer models can be helpful when building a physical model is difficult or too expensive. Computer software can be used to run calculations, eliminating the chance or human error. 3. Portfolios are collections of document selected for a particular purpose.	1. Identify and define the terminology used in engineering design and development. 2. Complete a design project utilizing all steps of a design process, and find a solution that meets specific design requirements. 3. Describe a variety of brainstorming techniques and rules for brainstorming. 4. Generate and document multiple ideas or solution paths to a problem through brainstorming. 5. Clearly justify and validate a selected solution path. 6. Construct a testable prototype of a problem solution. 7. Describe the design process used in the solution of a particular problem and reflect on all steps of the design process. 8. Analyze the performance of a design during testing and judge the solution as viable or non-viable with respect to meeting the design requirements. 9. Calculate statistics related to central tendency including mean, median, and mode. 10. Calculate statistics related to variation of data including standard deviation, interquartile range, and range. 11. Represent constraints with equations or inequalities. 12. Formulate equations and inequalities to represent linear**, quadratic, simple rational and exponential** relationships between quantities. 13. Solve equations for unknown quantities by determining appropriate substitutions for variables and manipulating the equations. 14. Interpret the slope (rate of change) and the intercept (constant term) of a linear function in the context of data. 15. Identify line types (including construction lines, object lines, hidden lines, cutting plane lines, section lines, and center lines) used on a technical drawing per ANSI Line Conventions and Lettering Y14.2M-2008 and explain the purpose of each line. 16. Create a set of working drawings to detail a design project. 17. Fabricate a simple object from technical drawings that may include an isometric view, orthographic projections, and a section view. 18. Dimension orthographic projections and section

	views of simple objects or parts according to a set of dimensioning standards and accepted practices. 19. Hand sketch isometric views of a simple object or part at a given scale using the actual object, a detailed verbal description of the object, a pictorial view of the object, or a set of orthographic projections. 20. Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints. 21. Compare the efficiency of the modeling method of an object using different combinations of additive and subtractive methods. 22. Generate CAD multi-view technical drawings, including orthographic projections, sections view(s), detail view(s), auxiliary view(s) and pictorial views, as necessary, showing appropriate scale, appropriate view selection, and correct view orientation to fully describe a part according to standard engineering practice. 23. Dimension and annotate (including specific and general notes) working drawings according to accepted engineering practice. Include dimensioning according to a set of dimensioning rules, proper hole and thread notes, proper tolerance annotation, and the inclusion of other notes necessary to fully describe a part according to standard engineering practice. 24. Explain each assembly constraint (including mate, flush, insert, and tangent), its role in an assembly model, and the degrees of freedom that it removes from the movement between parts. 25. Create assemblies of parts in CAD and use appropriate assembly constraints to create an assembly that allows correct realistic movement among parts. Manipulate the assembly model to demonstrate the movement. 26. Organize and express thoughts and information in a clear and concise manner. 27. Create drawings or diagrams as representations of objects, ideas, events, or systems.
Unit 5: Geometry of Design	
Essential Questions: 1. What are physical properties and why are they important to the design of a product? 2. What advantage does Computer Aided Design and Drafting (CAD) provide over traditional paper and pencil design? 3. How does the material chosen for a product impact the design of the product?	**Essential Understanding:** 1. An engineering design process involves a characteristic set of practices and steps. 2. A problem and the requirements for a successful solution to the problem should be clearly communicated and justified. 3. Brainstorming may take many forms and is used to generate a large number of innovative, creative ideas in a short time. 4. Physical models are created to represent and evaluate possible solutions using prototyping technique(s) chosen based on the presentation and/or testing requirements of a potential solution. 5. Problem solutions are optimized through evaluation and reflection and should be clearly

	communicated. 6. The scientific method guides the testing and evaluation of prototypes of a problem solution. 7. An equation is a statement of equality between two quantities that can be used to describe real phenomenon and solve problems. 8. Solving mathematical equations and inequalities involves a logical process of reasoning and can be accomplished using a variety of strategies and technological tools. 9. Units and quantitative reasoning can guide mathematical manipulation and the solution of problems involving quantities. 10. Error is unavoidable when measuring a physical property and a measurement is characterized by the precision and accuracy of the measurement. 11. Two- and three-dimensional objects share visual relationships which allow interpretation of one perspective from the other. 12. Physical properties of objects are used to describe and model objects and can be used to define design requirements, as a means to compare potential solutions to a problem, and as a tool to specify final solutions. 13. Functions describe a special relationship between two sets of data and can be used to represent real world relationships and to solve problems. 14. Geometric shapes and forms are described and differentiated by their characteristic features 15. Computer aided drafting and design (CAD) software packages facilitate virtual modeling of parts and assemblies and the creation of technical drawings. They are used to efficiently and accurately detail parts and assemblies according to standard engineering practice. 16. Computer aided drafting and design (CAD) software packages allow virtual testing and analysis of designs using 3D models, assemblies, and animations. 17. In order to be an effective team member, one must demonstrate positive team behaviors and act according to accepted norms, contribute to group goals according to assigned roles, and use appropriate conflict resolution strategies.

Curriculum Standards

IV – Information Technology Applications
- D – Evaluate and use skills relating to the differing technological tools used to manipulate, report, or operate with data acquisition.
  - 2 – Use modeling, simulation, or visual reproduction to effectively analyze, create, and/or communicate with others regarding plans, projects, problems, issues, or processes.

IX – Employability and Career Development
- A – Know and understand the importance of employability skills.
  - 1 – Identify and demonstrate positive work behaviors and personal qualities needed to be employable.

X – Technical Skills
- E – Applied Mathematics
  - 2 – Demonstrate knowledge of geometry.
- G – Geometric Construction
  - 1 – Draw lines and curved elements.

XI – Engineering Technology Pathway

A – Know the elements of the processes and concepts for understanding the design process.
2 – Explain the elements and steps of the design process and tools or techniques that can be used for each step.
B – Develop processes and concepts to apply the design process.
1 – Apply the design process, including understanding costumer needs, interpreting and producing design constraints and criteria, planning and requirements analysis, brainstorming and idea generation, using appropriate modeling and prototyping, testing, verification, and implementation.

Knowledge/Content Students will know about….	**Skills/Processes** Students will be able to……
1. Physical properties include volume, mass, density, and surface area. 2. Computer Aided Design and Drafting (CAD) allows a person to see and manipulate the object in 3D space. 3. All materials have certain characteristics, i.e. hardness, modulus of elasticity, malleability, etc.	1. Complete a design project utilizing all steps of a design process, and find a solution that meets specific design requirements. 2. Define and justify a design problem, and express the concerns, needs, and desires of the primary stakeholders. 3. Generate and document multiple ideas or solution paths to a problem through brainstorming. 4. Construct a testable prototype of a problem solution. 5. Identify limitations in the design process and the problem solution and recommend possible improvements or caveats. 6. Analyze the performance of a design during testing and judge the solution as viable or non-viable with respect to meeting the design requirements.
Unit 6: Reverse Engineering	
Essential Questions: 1. What considerations should be made when reverse engineering? 2. What makes a product aesthetically pleasing or eye-catching? 3. How are principles and elements of design used with engineering practice to develop a successful product?	**Essential Understanding:** 1. Material and fastener choices used in a product design should be carefully chosen based on the impact to the product's design, cost, performance, marketability, environmental impact, and expected service life. 2. Error is unavoidable when measuring a physical property and a measurement is characterized by the precision and accuracy of the measurement. 3. Technical drawings convey information according to an established set of drawing practices which allow for detailed and universal interpretation of the drawing. 4. Hand sketching of multiple representations to fully and accurately detail simple objects or parts of objects is a technique used to convey visual and technical information about an object. 5. Computer aided drafting and design (CAD) software packages facilitate virtual modeling of parts and assemblies and the creation of technical drawings. They are used to efficiently and accurately detail parts and assemblies according to standard engineering practice. 6. Computer aided drafting and design (CAD) software packages allow virtual testing and analysis of designs using 3D models, assemblies, and animations. 7. Technical professionals clearly and accurately document and report their work using technical writing practice in multiple forms.

	8. Specific oral communication techniques are used to effectively convey information and communicate with an audience. 9. Sketches, drawings, and images are used to record and convey specific types of information depending upon the audience and the purpose of the communication. 10. Visual elements and principles of design are part of an aesthetic vocabulary that is used to describe the visual characteristics of an object, the application of which can affect the visual appeal of the object and its commercial success in the marketplace. 11. Reverse engineering involves disassembling and analyzing a product or system in order to understand and document the visual, functional, and/or structural aspects of its design. 12. In order to be an effective team member, one must demonstrate positive team behaviors and act according to accepted norms, contribute to group goals according to assigned roles, and use appropriate conflict resolution strategies.

Curriculum Standards

I – Academic Foundations
- B – Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career.
  - 1 – Identify whole numbers, decimals, and fractions.
  - 2 – Demonstrate knowledge of basic arithmetic operations such as addition, subtraction, multiplication, and division.
  - 3 – Demonstrate use of rational expressions such as equal to, not equal, greater than, less than, etc.
  - 4 – Apply data and measurements to solve problems.
  - 5 – Analyze mathematical problem statements for missing and/or irrelevant data.
  - 6 – Construct charts/tables/graphs from functions and data.
  - 7 – Analyze data when interpreting operational documents.

III – Problem-Solving and Critical Thinking
- A – Effectively develop and apply the skills inherent in systems engineering where requirements, configuration, integration, project management, quality assurance, and process applications are necessary.
  - 1 – Employ critical thinking skills independently and in teams to solve problems and make decisions.
  - 2 – Use the skills required in project management to track and assess the progress of a plan, process, or project as assigned.

VII – Leadership and Teamwork
- A – Use leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.
  - 3 – Employ teamwork skills to achieve collective goals and use team members' talents effectively.

IX – Employability and Career Development
- A – Know and understand the importance of employability skills.
  - 1 – Identify and demonstrate positive work behaviors and personal qualities needed to be employable.

X – Technical Skills
- B – Employ planning and time management skills and tools to enhance results and complete work.
  - 1 – Develop goals and objectives.
  - 2 – Prioritize tasks to be completed.
- D – Preparing to Draw: Basic Drawing and Dimensioning Skills
  - 1 – Measure lines, angles, and geometric features.
  - 5 – Identify and create line types.
  - 6 – Identify and create sketches.
  - 7 – Complete title block and apply reference information.
  - 8 – Identify and complete a parts list/bill of materials.
  - 10 – Identify and operate design tools/instruments (CAD and/or manual).
- F – Identify Measurements

1 – Identify and read precision measurement tools.
2 – Calculate unit conversion.

H – Engineering Drawings
1 – Demonstrate knowledge of assembly and exploded assembly drawings.
2 – Identify abbreviations and symbols.

I – Multiview Drawings
1 – Demonstrate knowledge of multiview drawings.
4 – Identify common part features (fillets, rounds, draft angles, chamfers).

J – Section Views
1 – Identify and construct section views.

L – Dimensioning Skills
1 – Locate and describe features.
4 – Demonstrate knowledge of tolerances.
5 – Identify and label common mechanical feature notations.
6 – Place local and general notes including fonts, lettering, size, style, etc.
8 – Identify measurements.

XI – Engineering Technology Pathway

A – Know the elements of the processes and concepts for understanding the design process.
2 – Explain the elements and steps of the design process and tools or techniques that can be used for each step.

B – Develop processes and concepts to apply the design process.
1 – Apply the design process, including understanding costumer needs, interpreting and producing design constraints and criteria, planning and requirements analysis, brainstorming and idea generation, using appropriate modeling and prototyping, testing, verification, and implementation.

Knowledge/Content Students will know about….	**Skills/Processes** Students will be able to……
1. When reverse engineering a product, the structure, function, and operation of that object should be taken into account. 2. The color(s) used as well as the shape of objects are what make them aesthetically pleasing to the eye. 3. Design principles and elements are integrated into an object to make that object that object aesthetically pleasing to the eye, trying to make the object appear desirable to the consumer.	1. Evaluate and compare multiple materials and fastener choices for a product design based on the impact on the design's cost, performance, marketability, environmental impact, and expected service life. 2. Measure linear distances (including length, inside diameter, and hole depth) with accuracy using a scale, ruler, or dial caliper and report the measurement using an appropriate level of precision. 3. Determine the minimum number and types of views necessary to fully detail a part. 4. Choose and justify the choice for the best orthographic projection of an object to use as a front view on technical drawings. 5. Hand sketch isometric views of a simple object or part at a given scale using the actual object, a detailed verbal description of the object, a pictorial view of the object, or a set of orthographic projections. 6. Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints. 7. Generate CAD multi-view technical drawings, including orthographic projections, sections view(s), detail view(s), auxiliary view(s) and pictorial views, as necessary, showing appropriate scale, appropriate view selection, and correct view orientation to fully describe a part according to standard engineering practice. 8. Assign a specific material (included in the software library) to a part and use the capabilities of the CAD software to determine the mass, volume, and surface area of an object for which a 3D solid model has been created.

	9. Organize and express thoughts and information in a clear and concise manner. 10. Utilize an engineering notebook to clearly and accurately document the design process according to accepted standards and protocols to prove the origin and chronology of a design. 11. Deliver organized oral presentations of work tailored to the audience. 12. Select and utilize technology (software and hardware) to create high impact visual aids. 13. Identify and describe the visual principles and elements of design apparent in a natural or man-made object. 14. Define aesthetics and explain how the visual elements and principles of design affect the aesthetics and commercial success of a product. 15. Describe the process of reverse engineering. 16. Perform a functional analysis of a product in order to determine the purpose, inputs and outputs, and the operation of a product or system. • Perform a structural analysis of a product in order to determine the materials used and the form of component parts as well as the configuration and interaction of component parts when assembled (if applicable). • Analyze information gathered during reverse engineering to identify shortcoming of the design and/or opportunities for improvement or innovation. 17. Demonstrate positive team behaviors and contribute to a positive team dynamic.
Unit 7: Documentation	
Essential Questions: 1. How do you define a problem so that it can be effectively communicated and yield the best possible solution? 2. How does one know that a given design solution is the best possible solution? 3. How might a given solution be more or less acceptable to various types of stakeholders? 4. How do you select the best possible solution from multiple alternatives? 5. How do engineers communicate an object's dimensional information including the margin of acceptable error?	**Essential Understanding:** 1. An engineering design process involves a characteristic set of practices and steps. 2. Research derived from a variety of sources (including subject matter experts) is used to facilitate effective development and evaluation of a design problem and a successful solution to the problem. 3. A problem and the requirements for a successful solution to the problem should be clearly communicated and justified. 4. Brainstorming may take many forms and is used to generate a large number of innovative, creative ideas in a short time. 5. A solution path is selected and justified by evaluating and comparing competing design solutions based on jointly developed and agreed-upon design criteria and constraints. 6. Physical models are created to represent and evaluate possible solutions using prototyping technique(s) chosen based on the presentation and/or testing requirements of a potential solution. 7. Problem solutions are optimized through evaluation and reflection and should be clearly communicated. 8. Two- and three-dimensional objects share visual

	relationships which allow interpretation of one perspective from the other. 9. The scientific method guides the testing and evaluation of prototypes of a problem solution. 10. An equation is a statement of equality between two quantities that can be used to describe real phenomenon and solve problems. 11. Technical drawings convey information according to an established set of drawing practices which allow for detailed and universal interpretation of the drawing. 12. Dimensions, specific notes (such as hole and thread notes), and general notes (such as general tolerances) are included on technical drawings according to accepted practice and an established set of standards so as to convey size and location information about detailed parts, their features, and their configuration in assemblies. 13. A degree of variation always exists between specified dimensions and the measurement of a manufactured object which is controlled by the use of tolerances on technical drawings. 14. Hand sketching of multiple representations to fully and accurately detail simple objects or parts of objects is a technique used to convey visual and technical information about an object. 15. Computer aided drafting and design (CAD) software packages facilitate virtual modeling of parts and assemblies and the creation of technical drawings. They are used to efficiently and accurately detail parts and assemblies according to standard engineering practice. 16. Technical professionals clearly and accurately document and report their work using technical writing practice in multiple forms. 17. Sketches, drawings, and images are used to record and convey specific types of information depending upon the audience and the purpose of the communication. 18. Reverse engineering involves disassembling and analyzing a product or system in order to understand and document the visual, functional, and/or structural aspects of its design. 19. In order to be an effective team member, one must demonstrate positive team behaviors and act according to accepted norms, contribute to group goals according to assigned roles, and use appropriate conflict resolution strategies.

Curriculum Standards

II – Communications

E – Prepare STEM material in oral, written, or visual formats that provide information to an intended audience to fulfill specific communication need of an audience.

1 – Use effective methods to communicate concepts of STEM to a broadly represented audience.

2 – Effectively communicate STEM to a select audience.

3 – Apply the ability to read, interpret, and analyze STEM materials discerning the information and concepts.

IV – Information Technology Applications

D – Evaluate and use skills relating to the differing technological tools used to manipulate, report, or operate with data acquisition.

2 – Use modeling, simulation, or visual reproduction to effectively analyze, create, and/or communicate to others regarding plans, projects, problems, or processes.

E – Select and use different forms of communications technology including word processing, spreadsheets, database,

presentation software, emails to communicate, and use of the internet to search for and display information.
2 – Read and create basic computer aided engineering drawings.

IX – Employability and Career Development
A – Know and understand the importance of employability skills.
1 – Identify and demonstrate positive work behaviors and personal qualities needed to be employable.

X – Technical Skills
F – Identify Measurements
1 – Identify and read precision measurement tools.
2 – Calculate unit conversion.
H – Engineering Drawings
1 – Demonstrate knowledge of assembly and exploded assembly drawings.
2 – Identify abbreviations and symbols.
I – Multiview Drawings
1 – Demonstrate knowledge of multiview drawings.
4 – Identify common part features (fillets, rounds, draft angles, chamfers).
J – Section Views
1 – Identify and construct section views.
L – Dimensioning Skills
1 – Locate and describe features.
4 – Demonstrate knowledge of tolerances.
5 – Identify and label common mechanical feature notations.
6 – Place local and general notes including fonts, lettering, size, style, etc.
8 – Identify measurements.

XI – Engineering Technology Pathway
A – Know the elements of the processes and concepts for understanding the design process.
2 – Explain the elements and steps of the design process and tools or techniques that can be used for each step.
B – Develop processes and concepts to apply the design process.
1 – Apply the design process, including understanding costumer needs, interpreting and producing design constraints and criteria, planning and requirements analysis, brainstorming and idea generation, using appropriate modeling and prototyping, testing, verification, and implementation.

Knowledge/Content Students will know about….	**Skills/Processes** Students will be able to……
1. A design brief is written to effectively communicate the problem at hand, including the criteria and constraints. 2. Many times, the best possible solution to a design problem will have gone through multiple iterations after testing and evaluation. The design process is iterative in nature. 3. Every person's personal feelings towards what is the best idea/design will differ. Ultimately, the best design will be a combination of everyone's thoughts. 4. A decision matrix is used to rate possible design ideas against one another using specific criteria. 5. Engineers communicate the dimensional information of an object via working drawings that include either specific tolerances or a general tolerance note (or both).	1. Identify the steps in an engineering design process and summarize the activities involved in each step of the process. 2. Complete a design project utilizing all steps of a design process, and find a solution that meets specific design requirements. 3. Utilize research tools and resources (such as the Internet; media centers; market research; professional journals; printed, electronic, and multimedia resources; etc.) to gather and interpret information to develop an effective design brief. 4. Define and justify a design problem, and express the concerns, needs, and desires of the primary stakeholders. 5. Present and justify design specifications, and clearly explain the criteria and constraints associated with a successful design solution. 6. Write a design brief to communicate the problem, problem constraints, and solution criteria.

Unit 8: Advanced Computer Modeling	
Essential Questions: 1. How do you decide what to include in a set of working drawings? What views are needed? What other information is important? 2. How can assembly models, exploded assemblies, and animated assemblies of an object or a proposed design be used in the design process? Beyond the design process?	**Essential Understanding:** 1. An engineering design process involves a characteristic set of practices and steps. 2. Brainstorming may take many forms and is used to generate a large number of innovative, creative ideas in a short time. 3. Physical models are created to represent and evaluate possible solutions using prototyping technique(s) chosen based on the presentation and/or testing requirements of a potential solution. 4. Problem solutions are optimized through evaluation and reflection and should be clearly communicated. 5. The scientific method guides the testing and evaluation of prototypes of a problem solution. 6. An equation is a statement of equality between two quantities that can be used to describe real phenomenon and solve problems. 7. Solving mathematical equations and inequalities involves a logical process of reasoning and can be accomplished using a variety of strategies and technological tools. 8. Two- and three-dimensional objects share visual relationships which allow interpretation of one perspective from the other. 9. Geometric shapes and forms are described and differentiated by their characteristic features. 10. The style of the engineering graphics and the type of drawing views used to detail an object vary depending upon the intended use of the graphic. 11. Technical drawings convey information according to an established set of drawing practices which allow for detailed and universal interpretation of the drawing. 12. Dimensions, specific notes (such as hole and thread notes), and general notes (such as general tolerances) are included on technical drawings according to accepted practice and an established set of standards so as to convey size and location information about detailed parts, their features, and their configuration in assemblies. 13. A degree of variation always exists between specified dimensions and the measurement of a manufactured object which is controlled by the use of tolerances on technical drawings. 14. Hand sketching of multiple representations to fully and accurately detail simple objects or part of objects is a technique used to convey visual and technical information about an object. 15. Computer aided drafting and design (CAD) software packages facilitate virtual modeling of parts and assemblies and the creation of technical drawings. They are used to efficiently and accurately detail parts and assemblies according to standard engineering practice. 16. Technical professionals clearly and accurately

	document and report their work using technical writing practice in multiple forms. 17. Sketches, drawings, and images are used to record and convey specific types of information depending upon the audience and the purpose of the communication. 18. In order to be an effective team member, one must demonstrate positive team behaviors and act according to accepted norms, contribute to group goals according to assigned roles, and use appropriate conflict resolution strategies.

Curriculum Standards

I – Academic Foundations
- B – Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career.
  - 1 – Identify whole numbers, decimals, and fractions.
  - 2 – Demonstrate knowledge of basic arithmetic operations such as addition, subtraction, multiplication, and division.
  - 3 – Demonstrate use of rational expressions such as equal to, not equal, greater than, less than, etc.
  - 4 – Apply data and measurements to solve problems.
  - 5 – Analyze mathematical problem statements for missing and/or irrelevant data.
  - 6 – Construct charts/tables/graphs from functions and data.
  - 7 – Analyze data when interpreting operational documents.

II – Communications
- E – Prepare STEM material in oral, written, or visual formats that provide information to an intended audience to fulfill specific communication need of an audience.
  - 1 – Use effective methods to communicate concepts of STEM to a broadly represented audience.
  - 2 – Effectively communicate STEM to a select audience.
  - 3 – Apply the ability to read, interpret, and analyze STEM materials discerning the information and concepts.

III – Problem Solving and Critical Thinking
- B – Use mathematics, science, and technology concepts and processes to solve problems in projects involving design and/or production.
  - 3 – Use computer applications to solve problems by creating ans using algorithms, and through simulation and modeling techniques.

IV – Information Technology Applications
- D – Evaluate and use skills relating to the differing technological tools used to manipulate, report, or operate with data acquisition.
  - 2 – Use modeling, simulation, or visual reproduction to effectively analyze, create, and/or communicate to others regarding plans, projects, problems, or processes.
- E – Select and use different forms of communications technology including word processing, spreadsheets, database, presentation software, emails to communicate, and use of the internet to search for and display information.
  - 2 – Read and create basic computer aided engineering drawings.

IX – Employability and Career Development
- A – Know and understand the importance of employability skills.
  - 1 – Identify and demonstrate positive work behaviors and personal qualities needed to be employable.

X – Technical Skills
- F – Identify Measurements
  - 1 – Identify and read precision measurement tools.
  - 2 – Calculate unit conversion.
- H – Engineering Drawings
  - 1 – Demonstrate knowledge of assembly and exploded assembly drawings.
  - 2 – Identify abbreviations and symbols.
- I – Multiview Drawings
  - 1 – Demonstrate knowledge of multiview drawings.
  - 4 – Identify common part features (fillets, rounds, draft angles, chamfers).
- J – Section Views
  - 1 – Identify and construct section views.
- L – Dimensioning Skills

1 – Locate and describe features.
4 – Demonstrate knowledge of tolerances.
5 – Identify and label common mechanical feature notations.
6 – Place local and general notes including fonts, lettering, size, style, etc.
8 – Identify measurements.

XI – Engineering Technology Pathway
A – Know the elements of the processes and concepts for understanding the design process.
2 – Explain the elements and steps of the design process and tools or techniques that can be used for each step.
B – Develop processes and concepts to apply the design process.
1 – Apply the design process, including understanding costumer needs, interpreting and producing design constraints and criteria, planning and requirements analysis, brainstorming and idea generation, using appropriate modeling and prototyping, testing, verification, and implementation.

Knowledge/Content Students will know about….	**Skills/Processes** Students will be able to……
1. One must include any al all information that is pertinent to the manufacturing of a given part, assembly, etc. in their working drawings. 2. Assembly models, exploded assemblies, and animated assemblies of an object or a proposed design can allow the designer(s) to see how the interrelated parts of an object react together, mating parts can be checked for type of fit, and an overall better visualization of what is actually happening can be had. These files can also possibly be used for presentations of the final product as well as for marketing purposes.	1. Complete a design project utilizing all steps of a design process, and find a solution that meets specific design requirements. 2. Generate and document multiple ideas or solution paths to a problem through brainstorming. 3. Construct a testable prototype of a problem solution. 4. Identify limitations in the design process and the problem solution and recommend possible improvements or caveats. 5. Analyze the performance of a design during testing and judge the solution as viable or non-viable with respect to meeting the design requirements. 6. Formulate equations and inequalities to represent linear, relationships between quantities 7. Solve equations for unknown quantities by determining appropriate substitutions for variables and manipulating the equations. 8. Identify three dimensional objects generated by rotations of two-dimensional shapes and vice-versa. 9. Identify and differentiate geometric constructions and constraints such as horizontal lines, vertical lines, parallel lines, perpendicular lines, colinear points, tangent lines, tangent circles, and concentric circles. 10. Identify the proper use of each technical drawing representation including isometric, orthographic projection, oblique, perspective, auxiliary, and section views. 11. Choose and justify the choice for the best orthographic projection of an object to use as a front view on technical drawings. 12. Create a set of working drawings to detail a design project. 13. Create specific notes on a technical drawing to convey important information about a specific feature of a detailed object, and create general notes to convey details that pertains to information presented on the entire drawing (such as units, scale, patent details, etc. 14. Dimension orthographic projections and section views of simple objects or parts according to a set of dimensioning standards and accepted practices. 15. Identify and correctly apply chain dimensioning or datum dimensioning methods to a technical drawing.

	16. Model and annotate (with a hole note) through, clearance, blind, counter bore, and countersink holes. 17. Identify and differentiate among limit dimensions, a unilateral tolerance, and a bilateral tolerance. 18. Hand sketch orthographic projections at a given scale and in the correct orientation to fully detail an object or part using the actual object, a detailed verbal description of the object, or a pictorial an isometric view of the object. 19. Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints. 20. Generate CAD multi-view technical drawings, including orthographic projections, sections view(s), detail view(s), auxiliary view(s) and pictorial views, as necessary, showing appropriate scale, appropriate view selection, and correct view orientation to fully describe a part according to standard engineering practice. 21. Dimension and annotate (including specific and general notes) working drawings according to accepted engineering practice. Include dimensioning according to a set of dimensioning rules, proper hole and thread notes, proper tolerance annotation, and the inclusion of other notes necessary to fully describe a part according to standard engineering practice. 22. Create assemblies of parts in CAD and use appropriate assembly constraints to create an assembly that allows correct realistic movement among parts. Manipulate the assembly model to demonstrate the movement. 23. Create a CAD assembly drawing. Identify each component of the assembly with identification numbers and create a parts list to detail each component using CAD. 24. Utilize an engineering notebook to clearly and accurately document the design process according to accepted standards and protocols to prove the origin and chronology of a design 25. Create drawings or diagrams as representations of objects, ideas, events, or systems. 26. Demonstrate positive team behaviors and contribute to a positive team dynamic.
Unit 9: Design Team	
Essential Questions: 1. What are the advantages and disadvantages of a design team approach versus an individual approach in the problem solving process? 2. How do engineers and technical professionals impact society and the environment? 3. What strategies, skills, and tools are effective in facilitating communication and problem solving among team members that cannot meet face-to-	**Essential Understanding:** 1. An engineering design process involves a characteristic set of practices and steps. 2. Research derived from a variety of sources (including subject matter experts) is used to facilitate effective development and evaluation of a design problem and a successful solution to the problem 3. A problem and the requirements for a successful

face? 4. How can the use of a project schedule positively influence the design process?	solution to the problem should be clearly communicated and justified. 4. Brainstorming may take many forms and is used to generate a large number of innovative, creative ideas in a short time. 5. A solution path is selected and justified by evaluating and comparing competing design solutions based on jointly developed and agreed-upon design criteria and constraints. 6. Problem solutions are optimized through evaluation and reflection and should be clearly communicated. 7. Project planning tools and management skills are often used in the process of solving engineering design problems. 8. The style of the engineering graphics and the type of drawing views used to detail an object vary depending upon the intended use of the graphic. 9. Technical drawings convey information according to an established set of drawing practices which allow for detailed and universal interpretation of the drawing. 10. Dimensions, specific notes (such as hole and thread notes), and general notes (such as general tolerances) are included on technical drawings according to accepted practice and an established set of standards so as to convey size and location information about detailed parts, their features, and their configuration in assemblies. 11. A degree of variation always exists between specified dimensions and the measurement of a manufactured object which is controlled by the use of tolerances on technical drawings. 12. Hand sketching of multiple representations to fully and accurately detail simple objects or part of objects is a technique used to convey visual and technical information about an object. 13. Computer aided drafting and design (CAD) software packages facilitate virtual modeling of parts and assemblies and the creation of technical drawings. They are used to efficiently and accurately detail parts and assemblies according to standard engineering practice. 14. Styles and modes of professional correspondence are tailored to the type of audience and intended goals. 15. Technical professionals clearly and accurately document and report their work using technical writing practice in multiple forms. 16. Specific oral communication techniques are used to effectively convey information and communicate with an audience. 17. Sketches, drawings, and images are used to record and convey specific types of information depending upon the audience and the purpose of the communication. 18. Engineering has a global impact on society and the environment. 19. Engineering consists of a variety of specialist sub-fields, with each contributing in different ways to the design and development of solutions to different types of problems.

	20. Engineering design and practices are governed by ethics, values, and laws. 21. Visual elements and principles of design are part of an aesthetic vocabulary that is used to describe the visual characteristics of an object, the application of which can affect the visual appeal of the object and its commercial success in the marketplace. 22. Effective design teams can improve the efficiency and effectiveness of the design process. Effective team members have good collaboration skills. 23. In order to be an effective team member, one must demonstrate positive team behaviors and act according to accepted norms, contribute to group goals according to assigned roles, and use appropriate conflict resolution strategies. 24. Virtual design teams include people in different locations who collaborate using communication methods other than face-to-face contact.

Curriculum Standards

I – Academic Foundations

A – Demonstrate language arts knowledge and skills required to pursue the full range of postsecondary education and career opportunities.

1 – Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.

2 – Demonstrate use of the concepts, strategies, and systems for obtaining and conveying ideas and information to enhance communication in the workplace.

3 – Locate, organize and reference written information from various sources to communicate with co-workers and clients/participants.

4 – Evaluate and use information resources to accomplish specific occupational tasks.

5 – Use correct grammar, punctuation and terminology to write and edit documents.

6 – Develop and deliver formal and informal presentations using appropriate media to engage and inform audiences.

7 – Interpret verbal and nonverbal cues/behaviors to enhance communication with co-workers and clients/participants.

B – Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career.

1 – Identify whole numbers, decimals, and fractions.

2 – Demonstrate knowledge of basic arithmetic operations such as addition, subtraction, multiplication, and division.

3 – Demonstrate use of relational expressions such as equal to, not equal, greater than, less than, etc.

4 – Apply data and measurements to solve a problem.

6 – Construct charts/tables/graphs from functions and data.

7 – Analyze data when interpreting operational documents.

II – Communications

A – Develop and interpret tables, charts, and figures to support written and oral communications.

1 – Create tables, charts, and figures to support written and oral communications.

2 – Interpret tables, charts, and figures used to support written and oral communication.

B – Apply active listening skills to obtain and clarify information.

1 – Interpret a given verbal message/information.

2 – Respond with restatement and clarification techniques to clarify information.

3 – Model behaviors that demonstrate active listening.

C – Listen and speak with diverse individuals to enhance communication skills.

1 – Apply factors and strategies for communicating with a diverse workforce.

2 – Demonstrate ability to communicate and resolve conflicts within a diverse workforce.

D – Apply active listening skills to obtain or clarify information pertaining to plans, processes, projects, or designs.

1 – Interpret messages or information provided that clarifies issues, ideas, plans, projects, or processes.

2 – Respond and/or restate information that will clarify STEM techniques to be used and/or information to be applied to projects, plans, or processes.

E – Prepare STEM material in oral, written, or visual formats that provide information to an intended audience to fulfill specific communication need of an audience.

1 – Use effective methods to communicate concepts of STEM to a broadly represented audience.

2 – Effectively communicate STEM information to a select audience.

3 – Apply the ability to read, interpret, and analyze STEM materials discerning the information and concepts.

III – Problem Solving and Critical Thinking

A – Effectively develop and apply the skills inherent in systems engineering where requirements, configuration, integration, project management, quality assurance, and process applications are necessary.

1 – Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).

2 – Use the skills required in project management to track and assess the progress of a plan, process, or project as assigned.

4 – Employ critical thinking and interpersonal skills to resolve conflicts with staff and/or customers.

5 – Identify, write and monitor workplace performance goals to guide progress in assigned areas of responsibility and accountability.

6 – Conduct technical research to gather information necessary for decision-making.

B – Use mathematics, science, and technology concepts and processes to solve problems in projects involving design and/or production.

1 – Apply the core concepts of technology and recognize the relationships with STEM systems (e.g. systems, resources, criteria and constraints, optimization and trade-off, and controls).

2 – Develop the active use of information technology applications.

3 – Use computer applications to solve problems by creating and using algorithms, and through simulation and modeling techniques.

IV – Information Technology Applications

A – Use personal Information Management (PIM) applications to increase workplace efficiency.

1 – Manage personal schedules and contact information.

2 – Create memos and notes.

B – Employ technological tools to expedite workflow.

1 – Use information technology tools to manage and perform work responsibilities.

2 – Use email to share files and documents.

3 – Identify the functions and purpose of email systems.

4 – Use email to communicate within and across organizations.

5 – Access and navigate Internet (e.g., use a web browser).

6 – Search for information and resources.

7 – Evaluate Internet resources for reliability and validity.

8 – Prepare simple documents and other business communications.

9 – Prepare reports and other business communications by integrating graphics and other non-text elements.

12 – Deliver presentations with supporting materials.

13 – Create a spreadsheet.

14 – Perform calculations and analyses on data using a spreadsheet.

19 – Facilitate group work through management of shared schedule and contact information.

20 – Facilitate group work through management of shared files and online information.

21 – Facilitate group work through instant messaging or virtual meetings.

D – Evaluate and use skills relating to the differing technological tools used to manipulate, report, or operate with data acquisition.

1 – Use IT tools to manipulate data creating reports, plans, processes, or projects from data provided.

2 – Use modeling, simulation, or visual reproduction to effectively analyze, create, and/or communicate to others regarding plans, projects, problems, issues or processes.

5 – Apply a technological, scientific, or mathematical concept (use of algorithms) when communicating with others on issues, plans, processes, problems, or concepts.

E – Select and use different forms of communications technology including word processing, spreadsheets, database, presentation software, emails to communicate, and use of the internet to search for and display information.

1 – Select and use information technology tools to collect, analyze, synthesize, and display data to solve problems.

2 – Read and create basic computer aided engineering drawings.

V – Systems

A – Describe the nature and types of business organizations to build an understanding of the scope of organizations.

2 – Explain the functions and interactions of common departments within a business.

VII – Leadership and Teamwork

A – Use leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

1 – Employ leadership skills to accomplish organizational goals and objectives.

2 – Employ organizational and staff development skills to foster positive working relationships and accomplish organizational goals.

3 – Employ teamwork skills to achieve collective goals and use team members' talents effectively.

4 – Establish and maintain effective working relationships with all levels of personnel and other departments in order to accomplish objectives and tasks.
5 – Conduct and participate in meetings to accomplish work tasks.
6 – Employ mentoring skills to inspire and teach others.

IX – Employability and Career Development
A – Know and understand the importance of employability skills.
1 – Identify and demonstrate positive work behaviors and personal qualities needed to be employable.
2 – Manage resources in relation to the position (i.e. budget, supplies, computer, etc).

X – Technical Skills
A – Employ information management techniques and strategies in the workplace to assist in decision-making.
1 – Use information literacy skills when accessing, evaluating and disseminating information.
2 – Describe the nature and scope of information management.
B – Employ planning and time management skills and tools to enhance results and complete work tasks.
1 – Develop goals and objectives.
2 – Prioritize tasks to be completed.
3 – Develop timelines using time management knowledge and skills.
4 – Use project-management skills to improve workflow and minimize costs.
C – Apply concepts and processes for the application of technology to engineering.
1 – Use knowledge, techniques, skills, and modern tools necessary for engineering practice.
2 – Describe the elements of good engineering practice (e.g. understanding customer needs, planning requirements analysis, using appropriate engineering tools, prototyping, test, evaluation, and verification).
3 – Demonstrate the ability to characterize a plan and identify the necessary engineering tools that will produce a technical solution when given a problem statement.
4 – Effectively use project management techniques (e.g. working in teams, appropriate time management practices, effective organizational skills, conduct analysis of cost, resources, and production capacity, and quality practices with continuous improvement).
5 – Use and calibrate probes, sensors, measuring systems, and devices to collect data using traceable standards.
6 – Explain the impact of error in measurement, predict the effect of error propagation in calculations, and record data with the correct number of significant digits.
7 – Safely operate a variety of tools, machines, and equipment (e.g. milling machines, rapid prototyping machines, drill press, band saw, CNC machines, and hand tools).
8 - Use, handle, and store tools and materials correctly, perform preventative maintenance, understanding the results of negligence and improper maintenance or improper calibration.
D – Preparing to Draw: Basic Drawing and Dimensioning Skills
1 – Measure lines, angles, and geometric features
2 – Identify drawing views and details
3 – Identify assembly drawings, detailed drawings, and other drawings by type
4 – Identify revisions and apply engineering change information
5 – Identify and create line types
6 – Identify and create sketches
7 – Complete title block and apply reference information
8 - Identify and complete a parts list/bill of materials
9 – Select and interpret scale and paper size
10 – Identify and operate design tools/instruments (CAD and./or manual)
11 – Identify reference charts and tables
E – Applied Mathematics
1 – Demonstrate knowledge of mathematical operations.
2 – Demonstrate knowledge of geometry.
3 – Demonstrate knowledge of trigonometry.

F - Identify Measurements
1 – Identify and read precision measurement tools.
2 – Calculate unit conversion.
H – Engineering Drawings
1 – Demonstrate knowledge of assembly and exploded assembly drawings.
2 – Identify abbreviations and symbols.
3 – Demonstrate knowledge of pictorial drawings.
I – Multiview Drawings
1 – Demonstrate knowledge of multiview drawings.
2 – Multiview projection (third angle and first angle).

3 – Differentiate between major surface types (normal, inclined, oblique, cylindrical).
4 – Identify common part features (fillets, rounds, draft angles, chamfers).

J – Section Views
1 – Identify and construct section views.
2 – Identify ANSI material symbols.
3 – Apply section rules.

K – Auxiliary Views
1 – Identify and construct auxiliary views.
2 – Draw true view, true length lines, and true angles.

L – Dimensioning Skills
1 – Locate and describe features.
2 – Demonstrate knowledge of various unit dimensioning systems.
3 – Identify finished surfaces.
4 – Demonstrate knowledge of tolerances.
5 – Identify and label common mechanical feature notations.
6 – Place local and general notes including fonts, lettering size, style, etc.
8 – Identify measurements.

XI – Engineering Technology Pathway

A – Know the elements of the processes and concepts for understanding the design process.
2 – Explain the elements and steps of the design process and tools or techniques that can be used for each step.
3 – Describe design constraints, criteria, and trade-offs in regard to variety of conditions (e.g. technology, cost, safety, society, the environment, time, human resources, manufacturability).

B – Develop processes and concepts to apply the design process.
1 – Apply the design process, including understanding customer needs, interpreting and producing design constraints and criteria, planning and requirements analysis, brainstorming and idea generation, using appropriate modeling and prototyping, testing, verification, and implementation.
2 – Demonstrate the ability to evaluate a design or product and improve the design using testing, modeling, and research.
3 – Demonstrate the ability to record and organize information and test data during design evaluation.

Knowledge/Content Students will know about….	**Skills/Processes** Students will be able to……
1. Working on projects at a team, the workload can be spread out over all members, alleviating the amount of stress that an individual would have to endure taking on the project alone. Team projects do come with disadvantages, however, as now each person has to rely on others to do their job. 2. Engineers and technical professionals impact society and the environment by solving problems that currently exist. 3. The use of email, instant messaging, Skype, and the telephone are among the tools that will help team members that cannot meet face-to-face be able to work through a design project. 4. Using a project schedule will help ensure that the design process is moving forward in a timely fashion, deadlines are met, and that everyone knows what needs to be accomplished each day.	1. Identify the steps in an engineering design process and summarize the activities involved in each step of the process. 2. Complete a design project utilizing all steps of a design process, and find a solution that meets specific design requirements. 3. Utilize research tools and resources (such as the Internet; media centers; market research; professional journals; printed, electronic, and multimedia resources; etc.) to gather and interpret information to develop an effective design brief. 4. Define and justify a design problem, and express the concerns, needs, and desires of the primary stakeholders. 5. Define and justify a design problem, and express the concerns, needs, and desires of the primary stakeholders. 6. Write a design brief to communicate the problem, problem constraints, and solution criteria. 7. Generate and document multiple ideas or solution paths to a problem through brainstorming. 8. Use a decision matrix to evaluate and compare multiple design solutions in order to select a solution path that satisfies the design requirements. 9. Justify and validate a problem solution. 10. Identify limitations in the design process and the problem solution and recommend possible improvements or caveats. 11. Create and utilize a Gantt chart to plan, monitor, and control task completion during a design

	project. 12. Identify the proper use of each technical drawing representation including isometric, orthographic projection, oblique, perspective, auxiliary, and section views. 13. Create a set of working drawings to detail a design project. 14. Create specific notes on a technical drawing to convey important information about a specific feature of a detailed object, and create general notes to convey details that pertains to information presented on the entire drawing (such as units, scale, patent details, etc. 15. Dimension orthographic projections and section views of simple objects or parts according to a set of dimensioning standards and accepted practices. 16. Model and annotate (with a hole note) through, clearance, blind, counter bore, and countersink holes. 17. Identify and differentiate among limit dimensions, a unilateral tolerance, and a bilateral tolerance. 18. Generate non-technical concept sketches to represent an object or part to convey design ideas. 19. Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints. 20. Generate CAD multi-view technical drawings, including orthographic projections, sections view(s), detail view(s), auxiliary view(s) and pictorial views, as necessary, showing appropriate scale, appropriate view selection, and correct view orientation to fully describe a part according to standard engineering practice. 21. Dimension and annotate (including specific and general notes) working drawings according to accepted engineering practice. Include dimensioning according to a set of dimensioning rules, proper hole and thread notes, proper tolerance annotation, and the inclusion of other notes necessary to fully describe a part according to standard engineering practice. 22. Create assemblies of parts in CAD and use appropriate assembly constraints to create an assembly that allows correct realistic movement among parts. Manipulate the assembly model to demonstrate the movement. 23. Create a CAD assembly drawing. Identify each component of the assembly with identification numbers and create a parts list to detail each component using CAD. 24. Create an exploded view of a given assembly. Identify each component of the assembly with identification numbers, and create a parts list to detail each component using CAD. 25. Identify an appropriate mode of two-way communication based on the audience and intended goal of the communication. 26. Use an appropriate and professional tone and vernacular based on the audience of the correspondence. 27. Document correspondence and conversations in an

	accurate and organized manner. 28. Utilize an engineering notebook to clearly and accurately document the design process according to accepted standards and protocols to prove the origin and chronology of a design. 29. Deliver organized oral presentations of work tailored to the audience. 30. Select and utilize videos and images from CAD software to convey information appropriate for the given audience. 31. Assess the development of an engineered product and discuss its impact on society and the environment. 32. Describe the contributions of engineers from different engineering fields in the design and development of a product, system, or technology. 33. Identify and describe the steps of a typical product lifecycle (including raw material extraction, processing, manufacture, use and maintenance, and disposal. 34. Incorporate the use of the visual elements and principles of design in the design of an engineered product. 35. Identify and assign team member roles. 36. Define the term group norms and discuss the importance of norms in creating an effective team environment. 37. Demonstrate positive team behaviors and contribute to a positive team dynamic. 38. Identify appropriate technology to support remote collaboration among virtual design team members (such as asynchronous communications, audio and video conferencing, instant messaging, synchronous file editing, and file transfer). 39. Participate on a virtual team using remote collaboration tools to support team collaboration and problem solving.
Unit 10: Design Challenges	
Essential Questions: 1. How might we create the best possible solution to a problem? 2. What does one need to know in order to design the solution to a problem?	**Essential Understanding:** 1. An engineering design process involves a characteristic set of practices and steps. 2. Research derived from a variety of sources (including subject matter experts) is used to facilitate effective development and evaluation of a design problem and a successful solution to the problem. 3. A problem and the requirements for a successful solution to the problem should be clearly communicated and justified. 4. Brainstorming may take many forms and is used to generate a large number of innovative, creative ideas in a short time. 5. A solution path is selected and justified by evaluating and comparing competing design solutions based on jointly developed and agreed-upon design criteria and constraints. 6. Problem solutions are optimized through evaluation and reflection and should be clearly communicated. 7. The style of the engineering graphics and the type of drawing views used to detail an object vary

	depending upon the intended use of the graphic. 8. Technical drawings convey information according to an established set of drawing practices which allow for detailed and universal interpretation of the drawing. 9. Dimensions, specific notes (such as hole and thread notes), and general notes (such as general tolerances) are included on technical drawings according to accepted practice and an established set of standards so as to convey size and location information about detailed parts, their features, and their configuration in assemblies 10. A degree of variation always exists between specified dimensions and the measurement of a manufactured object which is controlled by the use of tolerances on technical drawings. 11. Hand sketching of multiple representations to fully and accurately detail simple objects or parts of objects is a technique used to convey visual and technical information about an object 12. Computer aided drafting and design (CAD) software packages facilitate virtual modeling of parts and assemblies and the creation of technical drawings. They are used to efficiently and accurately detail parts and assemblies according to standard engineering practice. 13. Technical professionals clearly and accurately document and report their work using technical writing practice in multiple forms. 14. Visual elements and principles of design are part of an aesthetic vocabulary that is used to describe the visual characteristics of an object, the application of which can affect the visual appeal of the object and its commercial success in the marketplace. 15. Effective design teams can improve the efficiency and effectiveness of the design process. Effective team members have good collaboration skills. 16. In order to be an effective team member, one must demonstrate positive team behaviors and act according to accepted norms, contribute to group goals according to assigned roles, and use appropriate conflict resolution strategies.

Curriculum Standards

I – Academic Foundations

A – Demonstrate language arts knowledge and skills required to pursue the full range of postsecondary education and career opportunities.

1 – Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.

2 – Demonstrate use of the concepts, strategies, and systems for obtaining and conveying ideas and information to enhance communication in the workplace.

3 – Locate, organize and reference written information from various sources to communicate with co-workers and clients/participants.

4 – Evaluate and use information resources to accomplish specific occupational tasks.

5 – Use correct grammar, punctuation and terminology to write and edit documents.

6 – Develop and deliver formal and informal presentations using appropriate media to engage and inform audiences.

7 – Interpret verbal and nonverbal cues/behaviors to enhance communication with co-workers and clients/participants.

B – Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career.

1 – Identify whole numbers, decimals, and fractions.

2 – Demonstrate knowledge of basic arithmetic operations such as addition, subtraction, multiplication, and division.

3 – Demonstrate use of relational expressions such as equal to, not equal, greater than, less than, etc.
4 – Apply data and measurements to solve a problem.
6 – Construct charts/tables/graphs from functions and data.
7 – Analyze data when interpreting operational documents.

II – Communications
A – Develop and interpret tables, charts, and figures to support written and oral communications.
1 – Create tables, charts, and figures to support written and oral communications.
2 – Interpret tables, charts, and figures used to support written and oral communication.
B – Apply active listening skills to obtain and clarify information.
1 – Interpret a given verbal message/information.
2 – Respond with restatement and clarification techniques to clarify information.
3 – Model behaviors that demonstrate active listening.
C – Listen and speak with diverse individuals to enhance communication skills.
1 – Apply factors and strategies for communicating with a diverse workforce.
2 – Demonstrate ability to communicate and resolve conflicts within a diverse workforce.
D – Apply active listening skills to obtain or clarify information pertaining to plans, processes, projects, or designs.
1 – Interpret messages or information provided that clarifies issues, ideas, plans, projects, or processes.
2 – Respond and/or restate information that will clarify STEM techniques to be used and/or information to be applied to projects, plans, or processes.
E – Prepare STEM material in oral, written, or visual formats that provide information to an intended audience to fulfill specific communication need of an audience.
1 – Use effective methods to communicate concepts of STEM to a broadly represented audience.
2 – Effectively communicate STEM information to a select audience.
3 – Apply the ability to read, interpret, and analyze STEM materials discerning the information and concepts.
F – Exhibit public relations skills to increase internal and external customer/client satisfaction.
1 – Communicate effectively when developing positive customer/client relationships.
2 – Use correct grammar to communicate verbally.
3 – Listen to a presentation and record important information. Report back identifying central themes and use key points to explain how the message applies to a similar situation.

III – Problem Solving and Critical Thinking
A – Effectively develop and apply the skills inherent in systems engineering where requirements, configuration, integration, project management, quality assurance, and process applications are necessary.
1 – Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).
2 – Use the skills required in project management to track and assess the progress of a plan, process, or project as assigned.
4 – Employ critical thinking and interpersonal skills to resolve conflicts with staff and/or customers.
5 – Identify, write and monitor workplace performance goals to guide progress in assigned areas of responsibility and accountability.
6 – Conduct technical research to gather information necessary for decision-making.
B – Use mathematics, science, and technology concepts and processes to solve problems in projects involving design and/or production.
1 – Apply the core concepts of technology and recognize the relationships with STEM systems (e.g. systems, resources, criteria and constraints, optimization and trade-off, and controls).
2 – Develop the active use of information technology applications.
3 – Use computer applications to solve problems by creating and using algorithms, and through simulation and modeling techniques.

IV – Information Technology Applications
B – Employ technological tools to expedite workflow.
5 – Access and navigate Internet (e.g., use a web browser).
6 – Search for information and resources.
7 – Evaluate Internet resources for reliability and validity.
D – Evaluate and use skills relating to the differing technological tools used to manipulate, report, or operate with data acquisition.
2 – Use modeling, simulation, or visual reproduction to effectively analyze, create, and/or communicate to others regarding plans, projects, problems, issues or processes.
5 – Apply a technological, scientific, or mathematical concept (use of algorithms) when communicating with others on issues, plans, processes, problems, or concepts.
E – Select and use different forms of communications technology including word processing, spreadsheets, database,

presentation software, email to communicate, and use of the internet to search for and display information.
2 – Read and create basic computer aided engineering drawings.

VII – Leadership and Teamwork
A – Use leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.
1 – Employ leadership skills to accomplish organizational goals and objectives.
2 – Employ organizational and staff development skills to foster positive working relationships and accomplish organizational goals.
3 – Employ teamwork skills to achieve collective goals and use team members' talents effectively.
4 – Establish and maintain effective working relationships with all levels of personnel and other departments in order to accomplish objectives and tasks.
5 – Conduct and participate in meetings to accomplish work tasks.
6 – Employ mentoring skills to inspire and teach others.

IX – Employability and Career Development
A – Know and understand the importance of employability skills.
1 – Identify and demonstrate positive work behaviors and personal qualities needed to be employable.
C – Demonstrate skills related to seeking and applying for employment to find and obtain a desired job.
11 – Engage in experiences in STEM where an individual can identify personal interests and expectations for career and personal development.

X – Technical Skills
A – Employ information management techniques and strategies in the workplace to assist in decision-making.
1 – Use information literacy skills when accessing, evaluating and disseminating information.
2 – Describe the nature and scope of information management.
B – Employ planning and time management skills and tools to enhance results and complete work tasks.
1 – Develop goals and objectives.
2 – Prioritize tasks to be completed.
3 – Develop timelines using time management knowledge and skills.
4 – Use project-management skills to improve workflow and minimize costs.
C – Apply concepts and processes for the application of technology to engineering.
1 – Use knowledge, techniques, skills, and modern tools necessary for engineering practice.
2 – Describe the elements of good engineering practice (e.g. understanding customer needs, planning requirements analysis, using appropriate engineering tools, prototyping, test, evaluation, and verification).
3 – Demonstrate the ability to characterize a plan and identify the necessary engineering tools that will produce a technical solution when given a problem statement.
4 – Effectively use project management techniques (e.g. working in teams, appropriate time management practices, effective organizational skills, conduct analysis of cost, resources, and production capacity, and quality practices with continuous improvement).
5 – Use and calibrate probes, sensors, measuring systems, and devices to collect data using traceable standards.
6 – Explain the impact of error in measurement, predict the effect of error propagation in calculations, and record data with the correct number of significant digits.
7 – Safely operate a variety of tools, machines, and equipment (e.g. milling machines, rapid prototyping machines, drill press, band saw, CNC machines, and hand tools).
8 - Use, handle, and store tools and materials correctly, perform preventative maintenance, understanding the results of negligence and improper maintenance or improper calibration.
D – Preparing to Draw: Basic Drawing and Dimensioning Skills
1 – Measure lines, angles, and geometric features
2 – Identify drawing views and details
3 – Identify assembly drawings, detailed drawings, and other drawings by type
4 – Identify revisions and apply engineering change information
5 – Identify and create line types
6 – Identify and create sketches
7 – Complete title block and apply reference information
8 - Identify and complete a parts list/bill of materials
9 – Select and interpret scale and paper size
10 – Identify and operate design tools/instruments (CAD and./or manual)
11 – Identify reference charts and tables
E – Applied Mathematics
1 – Demonstrate knowledge of mathematical operations.
2 – Demonstrate knowledge of geometry.
3 – Demonstrate knowledge of trigonometry.

F - Identify Measurements
1 – Identify and read precision measurement tools.
2 – Calculate unit conversion.

H – Engineering Drawings
1 – Demonstrate knowledge of assembly and exploded assembly drawings.
2 – Identify abbreviations and symbols.
3 – Demonstrate knowledge of pictorial drawings.

I – Multiview Drawings
1 – Demonstrate knowledge of multiview drawings.
2 – Multiview projection (third angle and first angle).
3 – Differentiate between major surface types (normal, inclined, oblique, cylindrical).
4 – Identify common part features (fillets, rounds, draft angles, chamfers).

J – Section Views
1 – Identify and construct section views.
2 – Identify ANSI material symbols.
3 – Apply section rules.

K – Auxiliary Views
1 – Identify and construct auxiliary views.
2 – Draw true view, true length lines, and true angles.

L – Dimensioning Skills
1 – Locate and describe features.
2 – Demonstrate knowledge of various unit dimensioning systems.
3 – Identify finished surfaces.
4 – Demonstrate knowledge of tolerances.
5 – Identify and label common mechanical feature notations.
6 – Place local and general notes including fonts, lettering size, style, etc.
8 – Identify measurements.

XI – Engineering Technology Pathway

A – Know the elements of the processes and concepts for understanding the design process.
2 – Explain the elements and steps of the design process and tools or techniques that can be used for each step.
3 – Describe design constraints, criteria, and trade-offs in regard to variety of conditions (e.g. technology, cost, safety, society, the environment, time, human resources, manufacturability).

B – Develop processes and concepts to apply the design process.
1 – Apply the design process, including understanding customer needs, interpreting and producing design constraints and criteria, planning and requirements analysis, brainstorming and idea generation, using appropriate modeling and prototyping, testing, verification, and implementation.
2 – Demonstrate the ability to evaluate a design or product and improve the design using testing, modeling, and research.
3 – Demonstrate the ability to record and organize information and test data during design evaluation.

Knowledge/Content Students will know about….	**Skills/Processes** Students will be able to……
1. We can create the best possible solution to a problem by following a design process. 2. In order to design the best possible solution to a problem, an individual needs to know the constraints that they have to work within and the criteria that the solution must meet.	1. Complete a design project utilizing all steps of a design process, and find a solution that meets specific design requirements. 2. Utilize research tools and resources (such as the Internet; media centers; market research; professional journals; printed, electronic, and multimedia resources; etc.) to validate design decisions and justify a problem solution. 3. Present and justify design specifications, and clearly explain the criteria and constraints associated with a successful design solution. 4. Generate and document multiple ideas or solution paths to a problem through brainstorming. 5. Use a decision matrix to evaluate and compare multiple design solutions in order to select a solution path that satisfies the design requirements. 6. Clearly justify and validate a selected solution path. 7. Describe the design process used in the solution of

	a particular problem and reflect on all steps of the design process. 8. Identify limitations in the design process and the problem solution and recommend possible improvements or caveats. 9. Identify the proper use of each technical drawing representation including isometric, orthographic projection, oblique, perspective, auxiliary, and section views. 10. Create a set of working drawings to detail a design project. 11. Create specific notes on a technical drawing to convey important information about a specific feature of a detailed object, and create general notes to convey details that pertains to information presented on the entire drawing (such as units, scale, patent details, etc. 12. Dimension orthographic projections and section views of simple objects or parts according to a set of dimensioning standards and accepted practices. 13. Determine the allowance between two mating parts of an assembly based on dimensions given on a technical drawing. 14. Generate non-technical concept sketches to represent an object or part to convey design ideas. 15. Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints. 16. Generate CAD multi-view technical drawings, including orthographic projections, sections view(s), detail view(s), auxiliary view(s) and pictorial views, as necessary, showing appropriate scale, appropriate view selection, and correct view orientation to fully describe a part according to standard engineering practice. 17. Dimension and annotate (including specific and general notes) working drawings according to accepted engineering practice. Include dimensioning according to a set of dimensioning rules, proper hole and thread notes, proper tolerance annotation, and the inclusion of other notes necessary to fully describe a part according to standard engineering practice. 18. Explain each assembly constraint (including mate, flush, insert, and tangent), its role in an assembly model, and the degrees of freedom that it removes from the movement between parts. 19. Create assemblies of parts in CAD and use appropriate assembly constraints to create an assembly that allows correct realistic movement among parts. Manipulate the assembly model to demonstrate the movement. 20. Utilize an engineering notebook to clearly and accurately document the design process according to accepted standards and protocols to prove the origin and chronology of a design. 21. Incorporate the use of the visual elements and principles of design in the design of an engineered product. 22. Identify and assign team member roles. 23. Demonstrate positive team behaviors and

	contribute to a positive team dynamic. 24. Establish common goals, equitable workloads, accountability, and create a set of team norms. 25. Contribute equitably to the attainment of group goals based on assigned roles.
Phase III Textbook/Materials	
Phase IV Summative Assessment Evidence	
Common Summative Unit Assessments:	**Agreed Upon Interim Summative Assessments:** (*identifies Performance Task)
Phase V Learning Plan	