Mechanical Engineering

LENGTH OF TIME: 1 semester, 90 minutes
GRADE LEVEL: 9 -12
COURSE STANDARDS:

Standard - 3.4.10.A2
Interpret how systems thinking applies logic and creativity with appropriate comprises in complex real-life problems.
Standard - 3.4.10.A3
Examine how technology transfer occurs when a new user applies an existing innovation developed for one purpose in a different function.
Standard - 3.4.10.B1
Compare and contrast how the use of technology involves weighing the trade-offs between the positive and negative effects.
Standard - 3.4.10.B2
Demonstrate how humans devise technologies to reduce the negative consequences of other technologies.
Standard - 3.4.10.B4
Recognize that technological development has been evolutionary, the result of a series of refinements to a basic invention.
Standard - 3.4.10.C1
Apply the components of the technological design process.
Standard - 3.4.10.C2
Analyze a prototype and/or create a working model to test a design concept by making actual observations and necessary adjustments.
Standard - 3.4.10.C3
Illustrate the concept that not all problems are technological and not every problem can be solved using technology.
Standard - 3.4.10.D1
Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of a final product.
Standard - 3.4.10.D2
Diagnose a malfunctioning system and use tools, materials, and knowledge to repair it.
Standard - 3.4.10.D3
Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and the environment.
Standard - 3.4.10.E2
Compare and contrast how the engineering design and management of agricultural systems require knowledge of artificial ecosystems and the effects of technological development on flora and fauna.
Standard - 3.4.10.E3
Compare and contrast the major forms of energy: thermal, radiant, electrical, mechanical, chemical, nuclear and others.
Standard - 3.4.12.A3
Demonstrate how technological progress promotes the advancement of science, technology, engineering and mathematics (STEM).
Standard - 3.4.12.C2
Apply the concept that engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.
Standard - 3.4.12.D2
Verify that engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.
Standard - 3.4.12.E3
Compare and contrast energy and power systems as they relate to pollution, renewable and non-renewable resources, and conservation.
Standard - 3.4.12.E4
Synthesize the effects of information and communication systems and subsystems as an integral part of the development of the Information Age.
Standard - 3.4.12.E5
Explain how the design of intelligent and non-intelligent transportation systems depends on many processes and innovative techniques.
Standard - 3.4.12.E6
Compare and contrast the importance of science, technology, engineering and math (STEM) as it pertains to the manufactured world.

Mechanical Engineering
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The students will develop an understanding of:

1. The Characteristics and Scope of Technology.
2. The Core Concepts of Technology.
3. The Relationships among Technologies and the connections between technology and other fields.
4. The cultural, social, economic, and political effects of technology.
5. The effects of technology on the environment.
6. The role of society in the development of and use of technology.
7. The influence of technology on history.
8. The Attributes of design.
9. Engineering Design.
10. The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
11. Apply the design process.
12. Use and maintain technological products and systems.
13. Assessing the impact of products and systems.
14. Medical technologies.
15. Agricultural and related biotechnologies.
16. Energy and power technologies.
17. Information and communication technologies.
18. Transportation technologies.
19. Manufacturing technologies.
20. Construction technologies.

PERFORMANCE ASSESSMENTS:

Students will demonstrate achievement of the standards by:

1. Developing solutions to engineering oriented problems including one-day technological projects and long term (12-14 week) design problems. The students are assessed according to their ability to utilize the concepts studied to design and analyze the effectiveness of their solutions to the technical problem. A rubric is used to evaluate the design brief, prototype, and presentation.

471996528. Forming a feeling of ownership regarding this process by developing and documenting the process through the analysis of specific, one-day, simple “real life” problems. The assessment will measure the implementation of the process when students are introduced to a new problem along with written and oral feedback at the end of the process.

471996360. Generating, organizing, typing and submitting a design brief outlining and justifying the steps taken in solving a particular engineering oriented problem. The report will be graded utilizing a rubric.

471996361. Presenting the process and results associated with their problem solving process to the rest of the class. A presentation will be utilized in the evaluation of the presentation.

471995128. All projects will involve short term and long term goals and milestones. These milestones will involve the collection and grading of material. The students will organize by utilizing the objective work sheet. Each group will use this work sheet to help establish objectives, identify tasks and assign responsibilities.

471996584. All projects will involve working in groups. The students within each group must effectively communicate throughout the problem solving procedure in order to present an in-depth analysis at each stage. The group will also use effective interpersonal skills in planning the manpower allocations associated with timely project completion. In order to develop and support this process, several team building exercises and short-term projects will be presented in the beginning of the course.

471996585. All projects will include, as part of the evaluation process, an assessment of the groups' ability to manage their manpower resources. Daily observance, with feedback and counseling by the instructor, will assist with this development.

471996586. All material submitted for grading, including all projects and papers, must be in typed format using MSWord. All numerical calculations associated with the development and testing of the student's solutions will be properly calculated, formatted and presented in graphical form utilizing computer spreadsheet software. All projects will require a set of Multiview drawings completed utilizing Autodesk Inventor.

DESCRIPTION OF COURSE:

Engineering Design – Mechanical Systems introduces basic engineering concepts such as force, work, rate, resistance, energy, power, and momentum and how to apply them in a mechanical system. Within the framework provided by these concepts, the student will develop a thinking process aimed at solving engineering design problems. The "Systems" approach on Input, Process, Output and Feedback is used exclusively as the problem solving process. The problem solving procedure developed in this course is an invaluable tool that can be used in any professional or personal situation the student may face now or in the future.

The ability to work with others and communicate through the written word, oral and visual methods are goals of the technology program. For these reasons, the students work in groups and are given a real problem to solve. By strictly defining the problem, brainstorming, discussing, building, testing and evaluating, the students will have to actually solve the given problem and present the results to the rest of the class. In addition to the presentation, the students construct a design brief outlining the procedure and justifying the decisions made and actions taken. In order to properly create this report. The student will create a set of manufacturing drawings using Autodesk Inventor. In addition to engineering problem solving, the student will be asked to explore various emerging technologies and to examine the role of technology in society and within our personal lives.

TITLES OF UNITS:

(all weeks listed below consist of five 90 minute classes)

1. Group Dynamics & The Problem Solving Procedure — ongoing
2. The Design Brief — ongoing
3. Career Exploration — 1 week

471998040. Resistance, Energy & Momentum in Mechanical Systems — 1 week

471998041. Manufacturing Processes/Prototype Construction — ongoing

471998042. Introduction to Spreadsheets & Computer Aided Design — 1 week

471998043. Rate, Work and Power in Mechanical Systems — 1 week

SAMPLE INSTRUCTIONAL STRATEGIES:

1. Internet research
2. Teacher demonstrations
   a. Manufacturing processes
   b. Computer aided design
   c. Presentation
   d. Multimedia
   e. Computer controlled machining
3. Brainstorming using the systems approach
4. Technical writing
5. Hands on activities

6. Mentoring - student

MATERIALS:
471997200. PC computers
471997201. MS Office 2000
471997202. Prototyping shop for manufacturing
471997203. Auto Cad
471997204. Autodesk Inventor
471997205. Autodesk Revit
471997206. Materials for construction
471997207. Web sits such as, but not limited to: Usfirst.org, Society of Mechanical Engineers.org, Autodesk.com, and Microsoft.com. Other sites would include local universities, colleges, and corporation.

METHODS OF ASSISTANCE AND ENRICHMENT:
Prior to fulfilling the requirements outlined in the Performance Assessment section, each student will be assisted through specific exercises aimed at the development of specific skills. This assistance will consist of providing examples of successful task completion. Proper application of concept principles, writing samples, presentation examples, proper computer software applications will be provided for the student in order to successfully paint a proper performance "target".

Enrichment will be provided by exposure to activities. Most enrichment will also occur through exposure to the massive amount of information available through on-line services and through the information gained for the successful completion of the brainstorming process associated with the problem solving procedure. In order to develop the reading skills necessary in efficient research, the students are often given reading assignments in class and required to extract the pertinent information. These reading assignments often provide an opportunity for the instructor to introduce "real world" applications of technical concepts. This provides another opportunity to introduce to the student, applications of current technologies.

PORTFOLIO DEVELOPMENT:
Design briefs demonstrating technical problem solving through technical concept analysis, the use of computer word processing, spreadsheet and computer aided design, organization, time management and communication skills are products of the Engineering Design – Mechanical Systems curriculum and strong components for the students' portfolio.

METHODS OF EVALUATION:
Evaluation of the student is integrated into the rubrics used to grade the reports, presentations and projects. In addition, evaluation of the course involves the observation of daily classroom activity by the instructor. Student groups will meet weekly with the instructor as a way to monitor and improve the progress of the design brief, prototype, and presentation.

INTEGRATED ACTIVITIES:
1. Concepts
-Researching mechanical devices and how they work
-Analyzing information and relating it to the design process
2. Communications
-Brochures in Publisher
-Proofreading skills
-Analyzing concepts such as speed and torque and integrating these concepts into the design
3. Thinking/Problem Solving

-Analyzing the feedback and using the information to make changes in the design
-Brainstorming

4. Application of Knowledge
-Infusion of science and technical concepts into the Input phase of the systems approach
-Using machines such as the mill and CNC router table to create a working prototype

5. Interpersonal Skills
-Interviewing professionals for feedback on possible solutions
-Working with another student on a design project