Unit 07: Microcontroller/3-D Modeling Integration

Content Area:	**Applied Technology**
Course(s):	
Time Period:	**Marking Period 3**
Length:	**6 Weeks**
Status:	**Published**

Summary

Introduction:

Engineering involves multiple disciplines. Students will develop a project that integrates computer programming skills and 3-D modeling skills. The project will be fully documented and presented. This is a culminating project for those taking the course for college credit.

Revision Date: July 2022

Standards

LA.W.11-12	Writing
	Research to Build and Present Knowledge
LA.W.11-12.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
CS.9-12.8.1.12.AP.1	Design algorithms to solve computational problems using a combination of original and existing algorithms.
CS.9-12.8.1.12.AP.2	Create generalized computational solutions using collections instead of repeatedly using simple variables.
CS.9-12.8.1.12.AP.5	Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.
CS.9-12.8.1.12.AP.6	Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.
CS.9-12.8.1.12.CS.2	Model interactions between application software, system software, and hardware.
CS.9-12.8.1.12.CS.3	Compare the functions of application software, system software, and hardware.
CS.9-12.8.1.12.CS.4	Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors.
CS.9-12.8.2.12.ED.1	Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.
CS.9-12.8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
CS.9-12.8.2.12.ED.3	Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.
CS.9-12.8.2.12.ED.4	Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.
CS.9-12.8.2.12.ED.5	Evaluate the effectiveness of a product or system based on factors that are related to its

	requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).
CS.9-12.8.2.12.ED.6	Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).
CS.9-12.8.2.12.NT.2	Redesign an existing product to improve form or function.
CS.9-12.AP	Algorithms & Programming
CS.9-12.CS	Computing Systems
CS.9-12.ED	Engineering Design
CS.9-12.NT	Nature of Technology
	Individuals evaluate and select algorithms based on performance, reusability, and ease of implementation.
	Programmers choose data structures to manage program complexity based on functionality, storage, and performance trade-offs.
	A computing system involves interaction among the user, hardware, application software, and system software.
	Engineering design is a complex process in which creativity, content knowledge, research, and analysis are used to address local and global problems. Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps that may involve redesigning for optimization.
	Complex programs are designed as systems of interacting modules, each with a specific role, coordinating for a common overall purpose. Modules allow for better management of complex tasks.
	The usability, dependability, security, and accessibility of devices within integrated systems are important considerations in their design as they evolve.
	Trade-offs related to implementation, readability, and program performance are considered when selecting and combining control structures.
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
	Engineers use science, mathematics, and other disciplines to improve technology. Increased collaboration among engineers, scientists, and mathematicians can improve their work and designs. Technology, product, or system redesign can be more difficult than the original design.
	Successful troubleshooting of complex problems involves multiple approaches including research, analysis, reflection, interaction with peers, and drawing on past experiences.

Essential Questions/Enduring Understandings

Essential Questions:

What do engineers do?

What do mechanical engineers do?

How do engineers solve problems?

How do engineers document their work?

Essential Understandings:

The development of machines involves multiple disciplines.

Mechanical engineers make machines.

The engineering design loop is an iterative process composed of a series of steps.

Engineering a product involves the integration of different disciplines.

Proper attribution to owners of work (patent and copyright) is expected.

Proper citing of intellectual resources follows standard practices. (MLA or APA)

Objectives

Students will know key terms: electric engineer, computer engineer, design loop, iterative, scientific method, design log, alternate solutions, brainstorming, design brief, evaluation, safety, microcontroller, computer language, flow chart, chassis, 3d printer terminology

Students will know the steps of the design loop and that it is iterative.

Students will know the contents of a design brief.

Students will know how to apply the design loop to a problem.

Students will know how to methodically document work in a design log.

Students will know how to give appropriate attribution to others authors and sources.

Students will know what a patent and copyright are and what plagiarism is.

Students will know how to use a microcontroller and 3D printer to develop a project.

Students will be skilled at identifying safety and fire are concerns when using electronics.

Students will be skilled at applying strategies and rules for maintaining a safe environment.

Students will be skilled at using unit vocabulary.

Students will be skilled at writing a design brief.

Students will be skilled at developing a project to meet the requirements to the design brief.

Students will be skilled at maintaining a schedule to meet deadlines.

Students will be skilled at iterative use of the design loop.

Students will be skilled at making a presentation.

Learning Plan

Preview the essential questions and connect them to learning throughout the unit.

Conduct formative assessments throughout the process using class discussion, student writing, and practice quizzes.

Assess to determine the students' background knowledge in the design loop and electrical engineering.

Provide guidance and rubrics for the development of a digital portfolio.

Provide lectures and lessons to develop students understanding of the design loop.

Problem-based learning: Students will develop a solution to a design problem graded with a rubric.

Provide guidance and rubrics for elements of the project: the design brief, the design log, evaluation of prototypes, and final project.

Complete summative assessments throughout to evaluate skills acquisition.

Conduct formative assessments throughout the design process.

Reflection paper to be graded with a rubric.

Complete unit summative assessments.

Assessment

Formative:

Participate in guided question and answer sessions, and group and individual discussions, and show an understanding of the purpose of the unit lesson(s), and their key terms and concepts.

Participate in classroom activities such as class discussion, and question and answer sessions.

Develop a digital portfolio that logs student activities throughout the year. The portfolio will be graded using a rubric.

Demonstrate the ability to utilize the design loop as a problem-solving tool.

Demonstrate the ability to document work in a design log that is assessed with a rubric.

Summative:

Demonstrate the ability to document work in a design log that is assessed with a rubric.

Demonstrate the ability to make a presentation that is assessed with a rubric.

Demonstrate the ability to properly attribute sources.

Demonstrate the ability to meet deadlines.

Demonstrate the ability to make a project that demonstrates understanding and knowledge of how to program and use a microcontroller and develop parts with a 3d printer.

Demonstrate understanding through written quizzes and tests about subject materials.

Meaningfully address the essential and guiding questions of this unit of study.

Final Presentation of project.

Benchmark:

Develop a digital portfolio that logs student activities throughout the year. The portfolio will be graded using a rubric.

Final exam

Alternative:

Oral exam

Project review

Materials

Textbook: Raymond B. Landis, Studying Engineering: A Road Map to a Rewarding Career (4th ed.). Discovery Press (ISBN-10: 0879348749, ISBN-13: 978-0979348747)

Robotics Lab, including: soldering irons, electric and manual drills/drill press, scroll saw, hand powered saws,

3-D printer and curing machine, safery glasses, hand operated tools like tin snips, wire cutters, electronic multi meters, power supplies, electronic components.

Computer Lab: Windows based computers with Autocad software, Arduino software, LEGO NXT software, CREO software, INTERNET connectivity.

Consumable materials: materials for 3d Printer, paper, wire, electronics components (speakers, transistors, capacitors, resistors etc).

White Board/LCD Screen

Online references from NJIT