Unit 3: Electrical Engineering Fundamentals

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 1**
Length: **3 Weeks**
Status: **Published**

Summary

Students will be introduced to the Bohr model of the atom, and develop an understanding of the properties of conductors and the components of circuits. OHm's Law and Kirchoff's Law will be used for circuit analysis. Students will develop an understanding of how circuits are made, soldering, and using a breadboard.

Revision Date: July 2024

Essential Questions/Enduring Understandings

Essential Questions:

What is the science that relates to electricity?

What do electrical engineers do, describe their jobs?

What factors affect electronic design?

Enduring Understandings:

a model of how electricity works helps us understand something we cannot see.

the mathematical relationships expressed by the laws help us solve problems in circuit design.

electronic circuits are designed to meet goals

Objectives

Students will know:

atomic structure as described in the Bohr model of the atom.

where to find conductors, semiconductors, and insulators on the periodic table.

that charge, current, voltage, and power are properties of electricity.

how to measure the value of resistance in a material with a meter.

how to compute the value of a resistor.

how to solder safely.

how to use a breadboard.

the characteristics of conductors and insulators.

Ohm's law.

Kirchhoff's laws regarding current and voltage.

how to compute equivalent resistance in parallel, series, and series-parallel circuits.

unit vocabulary, including but not limited to conductor, insulator, solder, schematic diagram, Ohm's Law, Kirchhoff's Law, breadboard, DC motor/DC Servo motor/AC motor, brown out, power supply, common, ground, etc.

Students will be skilled at:

computing equivalent unknown values in parallel, series, and series-parallel circuits.

how to measure resistance values with a meter.

how to use a breadboard for circuit prototyping.

to safely solder materials.

Learning Plan

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

Formative assessments will be conducted throughout the process using class discussion, student writing, and practice quizzes.

Formative assessments will be conducted to determine background knowledge of atomic theory.

Lectures and lessons will be provided to develop student understanding of electrical engineering concepts: Ohm's Law, Kirchhoff's Law, series, circuits, batteries, switches, parallel and series-parallel circuits.

Summative assessments will be conducted throughout to evaluate skills acquisition.

Formative assessments will be conducted throughout the design process.

Problem-based learning in mechanical/computer science engineering unit: students will design a touch sensor

for use in a circuit in a robot. Students will draw a schematic drawing of the circuit and explain how it works. Students will demonstrate correct use of a breadboard.

Summative assessment will be conducted by the student and teacher using a rubric specific to the design problem.

Students will develop skills in soldering

Complete unit test

Assessment

Formative assessment:

answer the essential and guiding questions for Electrical Engineering Fundamentals

participate in guided question and answer sessions, group and individual discussions, and demonstrate an understanding of the purpose of the unit lessons and the key terms and concepts.

participate in classroom activities such as class discussion, question and answer session, cooperative group projects and presentation of research.

Summative assessment:

written quizzes and tests about electrical engineering.

complete writing prompts. Examples: “Cars have a chassis that is 12V - ground, just like the Boe-Bot. Explain what this means. “Explain how you would approach fixing a broken table lamp with an Ohm meter”

Benchmark:

Final exam.

Alternate assessment:

Oral report, hands-on demonstration.

Materials

Online video tutorials

Email and e-board

Web sites

CAD and other software programs

Smartboard use for presentation and interactive lessons

Virtual Field Trips

Safety glasses

Sink/soap/water

Solder

Soldering irons

in class reference texts

Standards

ELA.K-12.1	Developing Responsibility for Learning: Cultivating independence, self-reflection, and responsibility for one's own learning.
ELA.K-12.2	Adapting Communication: Adapting communication in response to the varying demands of audience, task, purpose, and discipline.
ELA.L.SS.9–10.1	Demonstrate command of the system and structure of the English language when writing or speaking.
ELA.K-12.4	Building Knowledge: Building strong content knowledge and connecting ideas across disciplines using a variety of text resources and media.
ELA.L.KL.9–10.2	Apply knowledge of language to make effective choices for meaning, or style, and to comprehend more fully when reading, writing, speaking or listening.
ELA.L.VI.9–10.4	Demonstrate understanding of figurative language, word relationships, and nuances in word meanings, including connotative meanings.
TECH.K-12.1.4	Innovative Designer
	Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
TECH.K-12.1.4.a	know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
	Craft and Structure
TECH.K-12.1.4.b	select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
TECH.K-12.1.4.c	develop, test and refine prototypes as part of a cyclical design process.
MATH.9-12.A.REI	Reasoning with Equations and Inequalities
MATH.9-12.A.REI.A	Understand solving equations as a process of reasoning and explain the reasoning

TECH.K-12.1.4.d	exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.
	Integration of Knowledge and Ideas
TECH.K-12.1.5	Computational Thinker
TECH.K-12.1.5.a	formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
TECH.K-12.1.5.b	collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.
TECH.K-12.1.6	Creative Communicator
TECH.K-12.1.6.a	choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
ELA.W	Writing
SCI.HS-ETS1	Engineering Design
SCI.HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
	Asking Questions and Defining Problems
	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
	Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
SCI.HS.ETS1.A	Delimiting Engineering Problems
	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
	Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.
SCI.HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
	Constructing Explanations and Designing Solutions
	Constructing explanations and designing solutions 9–12 builds on K – experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.
	Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
SCI.HS.ETS1.C	Optimizing the Design Solution
	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed.
SCI.HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
	Constructing Explanations and Designing Solutions
SCI.HS.ETS1.B	Developing Possible Solutions

	When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
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.ED	Engineering Design
WRK.9.2.12.CAP	Career Awareness and Planning
WRK.9.2.12.CAP.4	Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
WRK.9.2.12.CAP.5	Assess and modify a personal plan to support current interests and post-secondary plans.
WRK.9.2.12.CAP.6	Identify transferable skills in career choices and design alternative career plans based on those skills.
WRK.9.2.12.CAP.7	Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.
WRK.9.2.12.CAP.8	Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
WRK.9.2.12.CAP.9	Locate information on working papers, what is required to obtain them, and who must sign them.
WRK.9.2.12.CAP.10	Identify strategies for reducing overall costs of postsecondary education (e.g., tuition assistance, loans, grants, scholarships, and student loans).
TECH.9.4.12.CI	Creativity and Innovation
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
TECH.9.4.12.CT	Critical Thinking and Problem-solving
TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
TECH.9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).

Career planning requires purposeful planning based on research, self-knowledge, and informed choices.

There are strategies to improve one's professional value and marketability.

Securing an income involve an understanding of the costs and time in preparing for a career field, interview and negotiation skills, job searches, resume development, prior experience, and vesting and retirement plans.

Innovative ideas or innovation can lead to career opportunities.

With a growth mindset, failure is an important part of success.

Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.

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.

Integrated Accommodation and Modifications, Special Education Students...

Integrated Accommodation and Modifications, Special Education students, English Language Learners, At-Risk students, Gifted and Talented students, Career Education, and those with 504s. Please see attached spreadsheet.