Unit 1.2: Introduction to Circuit Design

Content Area: **Science**
Course(s): **Digital Electro**
Time Period: **Semester 1**
Length: **5 weeks**
Status: **Published**

Standards

TEC.9-12.	The use of digital tools and media-rich resources enhances creativity and the construction of knowledge.
TEC.9-12.8.1.12.A.1	Construct a spreadsheet, enter data, and use mathematical or logical functions to manipulate data, generate charts and graphs and interpret the results.
WORK.9-12.9.1.12.1	The ability to recognize a problem and apply critical thinking and problem-solving skills to solve the problem is a lifelong skill that develops over time.
WORK.9-12.9.1.12.A	Critical Thinking & Problem Solving

Enduring Understandings

Understandings

Students will understand that ...

1. Waveforms can be used to trigger events in a circuit.
2. The concepts of frequency, wavelength, and duty cycle are all related to one another and can be calculated in a waveform.
3. Analog and digital signals have different waveforms with distinctive characteristics.
4. Analog signals have an infinite number of voltage levels that vary continuously over the voltage range for that particular system.
5. Digital signals have two well-defined voltage levels, one for a logic high and one for a logic low.
6. Circuit design processes have evolved over time to create circuits. These processes have changed as new strategies and new technologies have become available.
7. Engineers and technicians use Circuit Design Software (CDS) and instrumentation to verify functionality of their analog and digital design.

Essential Questions

Students will keep considering ...

1. What is the distinction between analog verses digital electronic circuits?
2. When is it appropriate to analyically design an engineering solution, vs. use technology to simulate the solution, vs. building and testing a physical prototype?
3. Why is the understanding of binary and decimal number systems essential to your ability to design combinational logic circuits?
4. How are calculations, computer software design (CDS) tools, and measurement tools used in electronics to guide development and troubleshoot a circuit?

Knowledge and Skills

Knowledge

Students will:

1. Know formulas for Ohm's Law, Kirchhoff's Voltage Law, and Kirchhoff's Current Law.
2. Know the characteristics of series, parallel, and combination circuits.
3. Identify digital and analog components.
4. Know the characteristics and differences between analog and digital signals and circuits.
5. Measure characteristics of a circuit using a digital multimeter (DMM).
6. Know the formulas for period, frequency, and duty cycle.
7. Relate schematic symbols to logic gates and logic gates to schematic symbols.
8. Relate truth tables to logic gates and logic gates to truth tables.
9. Relate logic expressions to logic gates and logic gates to logic expressions.
10. There is a formal design process for translating a set of design specifications into a functional circuit.

Skills

Students will …

1. Solve for unknown values within circuits (series, parallel, and combination circuits) using Ohm's Law, Kirchhoff's Voltage Law, and Kirchhoff's Current Laws.
2. Utilize Circuit Design Software (CDS) to validate hand calculations to analog circuit solutions.
3. Demonstrate series and parallel circuits on a breadboard.
4. Analyze simple analog circuits using a digital multimeter.
5. Analyze and interpret the amplitude, period, frequency, and duty cycle of analog and digital signals based on instrumentation and calculations.
6. Interpret the design of a simple 555 Timer oscillator and how the analog components affect the wave generated.
7. Utilize the Circuit Design Software (CDS) to simulate and test a complete analog design.
8. Use Circuit Design Software (CDS) to simulate and test a simple combinational logic circuit designed with AND, OR, and INVERTER gates.
9. Identify and describe the function of a D flip-flop.
10. Use Circuit Design Software (CDS) to simulate and test a simple sequential logic circuit design with D flip-flops.
11. Utilize the Circuit Design Software (CDS) to simulate and test a complete design containing both combinational and sequential logic.

Resources

Technology Resources

- National Instruments Multiim circuit design and simulation software
- Microsoft Office Applications

Electronics Resources

- Electronics Trainers (power supply, function generator, breadboard)
- Electronics hand tools (diagonal cutters, needle-nosed pliers, wire strippers, etc.)
- Digital Multimeters

Assessments

https://docs.google.com/document/d/1wR7bQF-8AQoRrt0g4C3hKja0yjwDjC9_BiAmONWbTcI/edit?usp=sharing

Modifications

https://docs.google.com/document/d/1ODqaPP69YkcFiyG72fIT8XsUIe3K1VSG7nxuc4CpCec/edit?usp=sharing