Piscataway High School

PLTW - DIGITAL ELECTRONICS - SYLLABUS

Digital Electronics (DE) is the study of electronic circuits that are used to process and control digital signals. In contrast to analog electronics, where information is represented by a continuously varying voltage, digital signals are represented by two discrete voltages or logic levels. This distinction allows for greater signal speed and storage capabilities and has revolutionized the world of electronics. Digital electronics is the foundation of all modern electronic devices such as cellular phones, MP3 players, laptop computers, digital cameras, high definition televisions, etc.

The major focus of the DE course is to expose students to the design process of combinational and sequential logic design, teamwork, communication methods, engineering standards, and technical documentation.

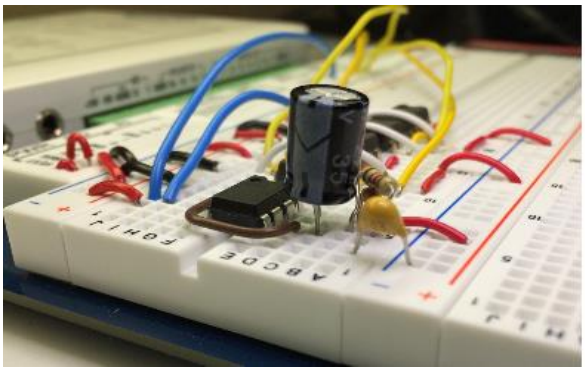
Utilizing the activity -, project-, and problem-based (APB) teaching and learning pedagogy, students will analyze, design and build digital electronic circuits. While implementing these designs, students will continually hone their interpersonal skills, creative abilities and understanding of the design process.

Digital Electronics is a high school level course that is appropriate for 10th or 11th grade students interested in electronics. Other than concurrent enrollment in college preparatory mathematics and science courses, this course assumes no previous knowledge.

The course applies and concurrently develops secondary level knowledge and skills in mathematics, science, and technology.

Unit 1: Foundations in Electronics

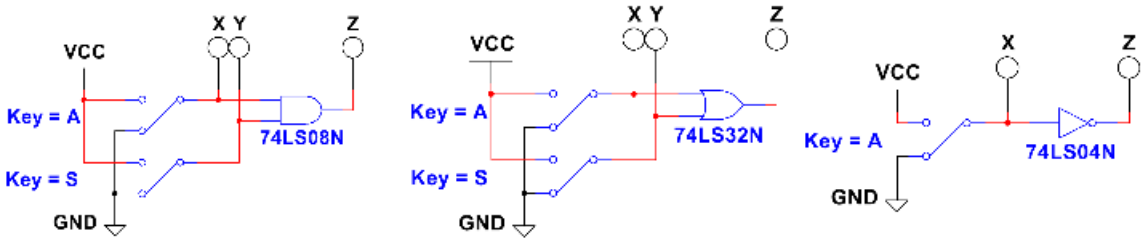
In Unit 1 Foundations in Electronics, students will explore the fundamental components, concepts, equipment, and skill sets associated with circuit design. They will learn an engineering design process that can be used to guide the creation of circuits based on a set of design requirements. Throughout the course students will learn about advancements in circuits and circuit design that have shaped the world of digital electronics.



555 Timer Circuit

Unit 2: Combinational Logic

How do you design a circuit to “do what you want it to do”? The goal of Unit 2 is for students to gain in-depth understanding of the combinational logic circuit design. Student will explore creation of circuits with discrete components and how to simplify these circuits to implement more efficient designs.

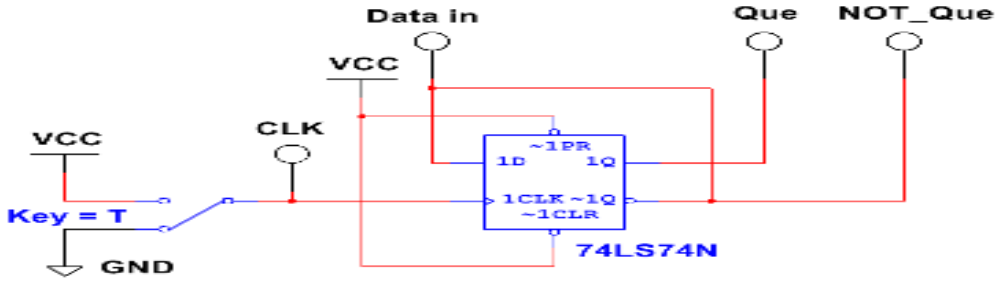


Combinational Logic Gates

Unit 3: Sequential Logic

How do you get a circuit to "do what you want it to do", "*when you want it to do it*"? Sequential logic introduces students to event detection and memory. Sequential logic has two characteristics that distinguish it from combinational logic. First, sequential logic must have a signal that controls the sequencing of events. Second, sequential logic must have the ability to remember past events.

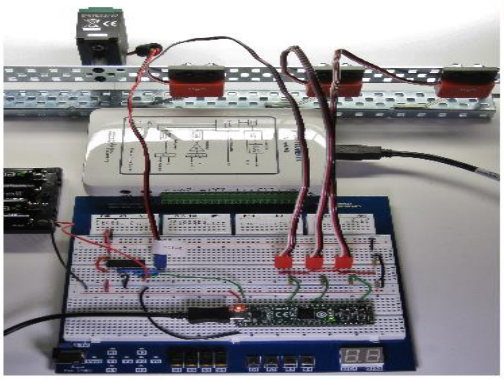
A keypad on a garage door opener is a classic example of an everyday device that utilizes sequential logic. On the keypad, the sequencing signal controls when a key can be pressed. The need to enter the passcode in a specific order necessitates memory of past events.
These characteristics are made possible by a simple device called a flip-flop. The flip-flop is a logic device that is capable of storing a logic level and allowing this stored value to change only at a specific time. For this reason the flip-flop is the fundamental building block for all sequential logic designs.



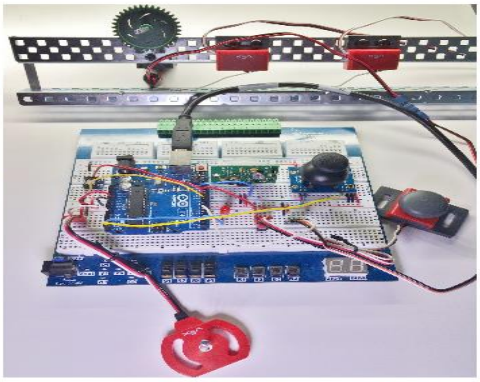
D Flip-Flop

Unit 4: Controlling Real World Systems

In Unit 4 students make the final transition from the transistor, to logic gates, to integrated circuits, to PLDs, to the microcontrollers and computers used widely today. State machines and embedded controllers allow student to integrate sensors and motors. This allows us to create circuits that exist in the world around us.



Copier Jam Detector Problem



Sensors, Motors, and Microcontrollers

PLTW - Digital Electronics - Course Outline

Unit 1 Foundations in Electronics (42 Total Days)

Lesson 1.1 Introduction to Electronics (21 Days)
Introduction to Safety, Electricity, and Components

Lesson 1.2 Introduction to Circuit Design (21 Days)
Introduction to Common Analog and Digital Circuit Designs and Applications

Unit 2 Combinational Logic (49 Total Days)

Lesson 2.1 AOI Combinational Logic Circuit Design (14 Days)
Designing AOI Combinational Logic Circuits

Lesson 2.2 Alternative Design: Universal Gates and K-Mapping (14 Days)
Alternative Design Processes to AOI and Boolean Simplification

Lesson 2.3 Specific Combinational Logic Designs (14 Days)
Common Combinational Logic Designs

Lesson 2.4 Introduction to Programmable Logic Devices (PLDs) (7 Days)
Introduction to PLD Design Mode and Circuit Prototyping on a PLD

Unit 3 Sequential Logic (56 Total Days)

Lesson 3.1 Sequential Logic Circuit Design (6 Days)
D Flip-Flops, J/K Flip-Flops, and Flip-Flop Applications

Lesson 3.2 Asynchronous Counters (25 Days)
SSI, MSI, and MOD Asynchronous Counters Counter Design

Lesson 3.3 Synchronous Counters (25Days)
SSI, MSI, and MOD Synchronous Counters Counter Design

Unit 4 Controlling Real World Systems (30 Total Days)

Lesson 4.1 Introduction to State Machines (20 Days)
Introduction to Sensors, Motors, and State Machine Design

Lesson 4.2 Introduction to Microcontrollers (10 Days)
Introduction to Microcomputers and Microcontrollers

Course Expectations:

Students will demonstrate:

- An ability to apply knowledge of Mathematics, Science, and Engineering
- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- An ability to function on multi-disciplinary teams
- An ability to identify, formulate, and solve Engineering problems
- An understanding of professional and ethical responsibility
- An ability to communicate effectively
- The broad education necessary to understand the impact of Engineering solutions in a global, economic, environmental, and societal context
- A recognition of the need for, and an ability to engage in life-long learning
- A knowledge of contemporary issues
- An ability to use the techniques, skills, and modern Engineering tools necessary for Engineering practice

Students will read at least 100 pages of technical material

Sample Course Activities/Projects/Problems/Assessments:

- Creating Schematics using Design Software
- Designing Circuits on a Breadboard
- Team and Individual Projects
- Presentations
- Application of algebraic concepts to circuitry

Lesson Protocol:

- Opening Do Now Activity: Anticipatory Activity or Review of previous learning
- Teacher Input/Q&A
  - Check for understanding
- Teacher Models Steps/Processes
  - Check for understanding
- Guided Practice: Students apply Steps/Processes with guidance
  - Check for understanding
- Independent Practice: Students work in teams or independently to complete material
- Closing Activity: Summarize learning and final check for understanding

Grading/Assessment Criteria

Category	% of Grade
Assessments	
Activities, Projects, Problems	50%
Engineering Notebook / Journal	10%
Exams / Homework Enrichment	20%
Classwork (Participation, Behavior, Effort, Collaboration)	20%
Total	**100 %**

Note/Late Assignment Policy

- *Grading Rubrics will be provided.*
- *Assignments must be presented to the instructor for grading.*
- *Assignments **not** submitted will be recorded as "ZERO".*
- *One point from earned grade will be deducted each day that an assignment is submitted late.*

Grading System

Letter Grade	Percentage	Adjustment TBA
A	90-100	
B	80-89	
C	70-79	
D	60-69	
F	0-59	

Class Policies

Behavioral Standards/Expectations

Students are expected to be punctual for class and ready for work.
Students are expected to follow class rules as well as school rules, which are implemented in the classroom.

Attendance

Tardy to Class

The Parents/Guardians of students who are habitually tardy will receive a telephone call after the third time student is tardy. Students are required to make up work missed due to being tardy.

Missed Exams/Assignments due to excused absences

Students who will be away from school for any period of time must inform me so that I can prepare assignments that the student can complete during time away from school.
There is no credit for missed assignments if students have been found to be cutting class. The assignments will be required to be completed and will be corrected; however, should the student want credit for these assignments she/he will be required to complete additional work.

Students will be allowed to make up work due to excused absences..