Digital Electronics is a course of study in applied digital logic that encompasses the design and application of electronic circuits and devices found in video games, watches, calculators, digital cameras, and thousands of other devices. Instruction includes the application of engineering and scientific principles as well as the use of Boolean algebra to solve design problems. Using computer software that reflects current industry standards, activities should provide opportunities for students to design, construct, test, and analyze simple and complex digital circuitry software will be used to develop and evaluate the product design. This course engages students in critical thinking and problem-solving skills, time management and teamwork skills. NOTE: Use of the PLTW Course number is limited to schools that have agreed to be part of the Project Lead the Way network and follow all training and data collection requirements.

- DOE Code: 4826
- Recommended Grade Level: Grade 11-12
- Required Prerequisites: Introduction to Engineering Design and Principles of Engineering
- Credits: 2 semester course, 2 semesters required, 1 credit per semester, maximum of 2 credits
- Fulfills a Directed Elective or Elective requirement for all diploma types
- Qualifies as a quantitative reasoning course

Application of Content and Multiple Hour Offerings
Intensive laboratory applications are a component of this course and may be either school based or work based or a combination of the two. Work-based learning experiences should be in a closely related industry setting. Instructors shall have a standards-based training plan for students participating in work-based learning experiences.

Content Standards
Domain – Lab and Electrical Wiring Safety
Core Standard 1 Students apply concepts of lab and electrical wiring safety to ensure a safe work environment.

  Standards
  DE-1.1 Demonstrate the use of wearing safety attire
  DE-1.2 State the safety purposes of properly handling materials such as solder, batteries
  DE-1.3 Identify the causes of and dangers of electric shock and explain the methods to prevent it
  DE-1.4 Design electronic circuits that involve the environmental concerns with creating safe circuits

Domain – Basic Laws of Electricity
Core Standard 2 Students evaluate the basic laws of electron theory and electricity in reference to solving parallel and series circuits.

  Standards
  DE-2.1 Design circuit boards that integrate parallel circuits
  DE-2.2 Design circuit boards that integrate series circuits
  DE-2.3 Calculate Ohm’s Law to for simple series and parallel circuits
DE-2.4 Identify and label the parts of an atom and what elements are good conductors, insulators, and semiconductors
DE-2.5 Explain Quantum energy in relationship to electrons classified as insulators or conductors
DE-2.6 Calculate Kirchhoff’s Voltage Law for simple series and parallel circuits
DE-2.7 Calculate Kirchhoff’s Current Law for simple series and parallel circuits
DE-2.8 Define and explain Alternating Current and Direct Current

Domain – Electrical Components
Core Standard 3 Students apply concepts of the basic electrical components to design and create.

Standards
DE-3.1 Summerize the material makeup of resistors and how they are used in circuit design
DE-3.2 Relate the symbols associated with resistors and how they function
DE-3.3 Calculate tolerance levels of various resistors to determine if the measured value is within specifications
DE-3.4 Analyze the component parts of a capacitor and how it holds a static charge
DE-3.5 Identify and describe the units of measurements for capacitors
DE-3.6 Calculate the values of capacitors and their voltage polarity requirements
DE-3.7 Distinguish the different types of capacitors and their voltage polarity requirements

Domain – Digital Logic Circuits
Core Standard 4 Students create and analyze digital logic circuits for knowledge, accuracy and efficiency.

Standards
DE-4.1 Recognize the relationship between the Boolean expression, logic diagram, and the truth table
DE-4.2 Design Boolean Expressions, logic circuit diagrams or truth tables from information provided in the solution of design problems
DE-4.3 Select the Sum-of Products or the Products-of-Sums form of a Boolean Expression to use in the solution of a problem
DE-4.4 Apply the rules of Boolean algebra to logic diagrams and truth tables to minimize the circuit size necessary to solve a design problem
DE-4.5 Demonstrate DeMorgan’s to simplify a negated expression and to convert a SOP to a POS and visa versa in order to same resources in the production of circuits
DE-4.6 Formulate and employ a Karnaugh Map to reduce Boolean expressions and logic circuits to their simplest forms
DE-4.7 Create circuits to solve a problem using NAND or NOR gates to replicate all logic functions
DE-4.8 Apply their understanding of the workings of NOR and NAND gates to make comparisons with standard combinational logic solutions to determine amount of resource reduction
DE-4.9 Use schematics and symbolic Algebra to represent digital gates in the creation of solutions to design problems
DE-4.10 Identify the name, symbol, and function and create truth tables and Boolean Expression for the basic logic gates through research and experimentation
DE-4.11 Apply logic to design and create, using gates, solutions to a problem
DE-4.12 Assemble circuits and compile information about the various applications of flip-flops.

**Domain – AC Waveforms and AC Voltage Generation**

**Core Standard 5** Students analyze the characteristics of AC waveforms and AC voltage generation to validate signals.

**Standards**

- DE-5.1 Analyze a digital waveform and identify the anatomy of the waveform
- DE-5.2 Differentiate between digital and analog signals when given the waveforms
- DE-5.3 Design, create and test circuits
- DE-5.4 Calculate the output frequency of circuits using observations and the oscilloscope

**Domain – Single and Three Phase AC Power**

**Core Standard 6** Students analyze single and three phase AC power to understand the single versus three phase systems.

**Standards**

- DE-6.1 None

**Domain – Soldering, Equipment, Supplies**

**Core Standard 7** Students will establish a working and functional knowledge of the software and equipment used in designing and troubleshooting circuits.

**Standards**

- DE-7.1 Create circuits using circuit design software
- DE-7.2 Test circuit/measure values using a Digital Multi-Meter
- DE-7.3 Demonstrate successful soldering and desoldering techniques
- DE-7.4 Demonstrate breadboarding techniques
- DE-7.5 Identify the appropriate tools for working on circuit systems using safety guidelines

**Domain – Number Systems, Simplifying**

**Core Standard 8** Students will convert and calculate number systems and sequences to work with large numbers, small numbers, and simplify problems.

**Standards**

- DE-8.1 Convert numbers between the binary and decimal number systems
- DE-8.2 Translate design specifications into truth tables
- DE-8.3 Construct truth tables from logic expressions
- DE-8.4 Understand numerical place value
- DE-8.5 Use mathematical symbols to represent bases and will communicate concepts using different number systems
- DE-8.6 Demonstrate the relationship of binary and hexadecimal to bits and bytes of information used in computers
- DE-8.7 Convert values from one number systems to another
- DE-8.8 Design, construct and test adder circuits using both discrete and MSI gates
- DE-8.9 Re-write any number using conventional prefix definitions
- DE-8.10 Demonstrate understanding of binary addition and subtraction
- DE-8.11 Create and prove truth tables
Domain – Microprocessors

Core Standard 9 Students design and create a microprocessor to understand the full impact of design, creation and implementation of a processor.

Standards
DE-9.1 Formulate to flow chart to correctly apply basic programming concepts in the planning of a project

Career and Technical Student Organizations

Career and Technical Student Organizations are considered a powerful instructional tool when integrated into Career and Technical Education programs. They enhance the knowledge and skills students learn in a course by allowing a student to participate in a unique program of career and leadership development. Students should be encouraged to participate in a Career and Technical Student Organization, such as the Technology Student Association (TSA).