Indiana Department of Education
Academic Standards Course Framework

DIGITAL ELECTRONICS PLTW

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).**