Digital Electronics

	Performance Objectives	Show-Me Content	Show-Me Goals	National Standards	Alignment
1.1	**Safety**				
1.	Identify hazards in the lab and know locations of the safety equipment and how to use it.	H/PE6	4.7	12:9-12O	A
2.	Understand the causes of and the dangers from electric shock and explain methods to prevent it.	CA1, H/PE6	4.7	12:9-12O	A
3.	Understand that the process of designing an electronic circuit takes into account many factors, including environment concerns, and be familiar with precautionary measures.	SC8	3.1, 3.8, 4.7	9:9-12L	A
1.2	**Electron Theory**				
1.	Label the parts of the atom.	CA1, SC1		16:9-12J	B
2.	Explain the relationship of quantum energy required to strip away electrons from atoms to being classified as an insulator or conductor.	CA1, SC1		16:9-12J	C
3.	Define and explain the difference between direct and alternating currents.	CA1, SC1		16:9-12K	C
1.3	**Scientific Prefixes**				
1.	Re-write any number using conventional prefix definitions.	MA5			C
1.4	**Resistance**				
1.	Understand the material makeup of resistors and how they are used in circuit design.	SC1		19:9-12M	C
2.	Understand the symbols associated with resistors.	SC1		17:9-12Q	C
3.	Correctly setup lab equipment to measure resistor values in order to compare measured and rated values.	SC1		12:6-8I	C
4.	Calculate the tolerance levels of various resistors to determine if the measured value is within specifications.	MA1		12:6-8H	C
1.5	**Laws**				
1.	Draw and label the parts of a simple circuit.	SC1		2:9-12Y, 17:6-8K	C
2.	Build and test a variety of series and parallel circuits, using simulation software and proto-boards, to prove the accuracy of Ohm's and Kirchhoff's laws.	SC1, SC7	3.1, 3.5	16:9-12J	C
3.	Select and utilize electrical meters correctly to determine voltage, resistance, and current in simple circuits.	MA1, SC1		12:6-8I, 16:6-8G	C
4.	Calculate the resistance, current, and voltage in a circuit using Ohm's Law.	MA1, SC1		16:9-12J	C

1.6	**Capacitance**				
1.	Describe the component parts of a capacitor and describe how a capacitor holds a static charge.	CA1, SC1			C
2.	Understand and use the units of measurement for capacitors.	MA1			C
3.	Calculate the value of capacitors mathematically and through the use of instrumentation.	MA1		12:6-8I	C
4.	Describe different types of capacitors and their voltage polarity requirements.	CA1, SC1			C
1.7	**Analog and Digital Waveforms**				
1.	Draw a digital waveform and identify the anatomy of the waveform.	SC1			C
2.	Differentiate between digital and analog signals when given the waveforms.	SC1			C
3.	Wire and test a free-running clock circuit using a 555 timer.	SC1	2.5	2:6-8M	C
4.	Calculate the output frequency of a clock circuit using observations and the oscilloscope.	MA1, SC1		12:6-8I	C
1.8	**Obtaining Data Sheets**				
1.	Successfully complete an Internet search for data sheets for integrated circuits.		1.4	12:9-12P	B
2.	Describe the information contained on a data sheet.	CA1			B, L
2.1	**Number Conversions**				
1.	Understand numerical place value.	MA1			B
2.	Apply mathematical symbols to represent different bases and communicate concepts using different number systems.	MA5		17:9-12Q	D
3.	Demonstrate the relationship of binary and hexadecimal to bits and bytes of information used in computers.	MA5		17:9-12Q	D
4.	Convert values from one number system to another.	MA5		17:9-12Q	D
3.1	**Logic Gates**				
1.	Use schematics and symbolic algebra to represent digital gates in the creation of solutions to design problems.	MA4	2.5	11:6-8H	E
2.	Identify the name, symbol, and function and create the truth table and Boolean Expression for the basic logic gates through research and experimentation.	MA4	1.2, 3.1, 3.2, 3.3	17:9-12Q	E
3.	Apply logic gates to design and create solutions to a problem.	MA4	3.7	11:6-8H	E
4.1	**Boolean Expressions**				

1.	Recognize the relationship between the Boolean expression, logic diagram, and truth table.	MA4		3:6-8F	E
2.	Create Boolean Expressions, logic circuit diagrams or truth tables from information provided in the solution of design problems.	MA4	1.8, 3.1	11:9-12N	E
3.	Select the Sum-of-Products or the Product-of-Sums form of a Boolean Expression to use in the solution of a problem.	MA4	3.2, 3.3	11:9-12N	E
4.2	**Logic Simplification**				
1.	Apply the rules of Boolean algebra to logic diagrams and truth tables to minimize the circuit size necessary to solve a design problem.	MA4	3.1, 3.2, 3.3	11:9-12O	F
2.	Apply DeMorgan's Theorem to simplify a negated expression and to convert a SOP to a POS and visa versa in order to save resources in the production of circuits.	MA4	3.1, 3.2, 3.3	11:9-12O	F
3.	Formulate and employ a Karnaugh Map to reduce Boolean Expressions and logic circuits to their simplest forms.	MA4, MA6	3.1, 3.2, 3.3	11:9-12O	F
4.3	**Duality of Logic Functions**				
1.	Create circuits to solve a problem using NAND or NOR gates to replicate all logic functions.	MA4	3.1, 3.2, 3.3	11:9-12N	G
2.	Apply understanding of the workings of NOR and NAND gates to make comparisons with standard combinational logic solutions to determine amount of resource reduction.	MA4	3.1, 3.2, 3.3	11:9-12O	G
5.1	**Solving Combinational Logic Problems**				
1.	Restate and simplify a digital design problem as part of the systematic approach to solving a problem.	MA4	3.1, 3.2, 3.3	11:9-12N	H
2.	Design, construct, build, troubleshoot, and evaluate a solution to a design problem.		2.5, 3.1, 3.2, 3.3, 3.7	11:9-12Q	H
3.	Present an oral report presenting a solution and evaluation of a design problem of choice.	CA1, CA6	1.8, 2.1	11:9-12R	N
5.2	**Applications of MSI**				
1.	Discover the code to create numbers on a seven segment display by experimentation.	SC7	3.1, 3.3, 3.5	1:9-12L	H
2.	Design a circuit to control a seven segment display with a decimal to BCD encoder and a display driver.	MA1	2.5	11:9-12N	H
3.	Control the flow of data by utilizing Multiplexers and Demultiplexers.		3.2	12:9-12P	H
5.3	**Programmable Logic Devices**				
1.	Design and implement combinational logic circuits using reprogrammable logic devices.	MA1	2.5, 3.1, 3.2, 3.3	11:9-12N	H

2.	Create PLD logic files that define combinational circuit designs using Boolean Expressions.	MA4	3.1, 3.2, 3.3	11:9-12O	H
3.	Understand and use logic compiler software to create JEDEC files for programming PLDs.		3.1, 3.2	11:9-12Q	H
6.1	**Binary Addition**				
1.	Demonstrate understanding of binary addition and subtraction by designing circuits to produce correct answers.	MA5		11:6-8H	I
2.	Create and prove the truth table for both half and full adders.	MA5	3.1, 3.2, 3.3, 3.7	11:9-12P	I
3.	Design, construct, and test adder circuits using both discrete gates and MSI gates.	MA5	2.5, 3.1, 3.2, 3.3, 3.7	11:9-12P, 17:6-8I	I
7.1	**Introduction to Sequential Logic**				
1.	Construct and test simple latches and flip-flops from discrete gates.	MA5	3.1, 3.2, 3.3, 3.7	11:9-12P	J
2.	Interpret, design, draw, and evaluate circuits using the logic symbols for latches and flip-flops.	MA5	3.1, 3.2, 3.3, 3.7	11:9-12P	J
3.	Construct circuits, interpret the waveform diagrams, and compare them with combinational waveforms.	MA5	1.8, 3.1, 3.2, 3.3	11:9-12Q	J
7.2	**The JK Flip-Flop**				
1.	Compare and contrast operation of synchronous with asynchronous flip-flop circuits constructed.	MA5	1.8	12:6-8K	J
2.	Create and interpret timing diagrams and truth tables for JK Flip-Flops.	MA5	1.8		J
7.3	**Triggers**				
1.	Understand the different types of triggers used by latches and flip-flops and select the appropriate one for designed circuits.		3.7	11:9-12N	J
2.	Analyze timing diagrams that reflect triggering to identify distinguishing characteristics.		3.1	11:9-12P	J
7.4	**Design Considerations**				
1.	Conduct experiments with clock pulse width to determine the effect on the accuracy of data transmission.	SC1, SC7	1.8, 3.1	10:6-8H	J
7.5	**Elementary Applications of Flip-Flops**				
1.	Assemble circuits and compile information about the various applications of flip-flops.	CA4, SC1	1.8, 2.5	11:9-12Q	J
8.1	**Shift Registers**				

1.	Conduct experiments to determine the basic principles of how shift registers work.	SC7	1.2	10:6-8H	K
2.	Evaluate the use of shift registers in product design and the speeds at which those products run.		3.7		K
8.2	**Asynchronous Counters**				
1.	Create a circuit using discrete flip-flops to discover the operation and characteristics of asynchronous counters.	MA5	2.5	11:9-12P	K
8.3	**Synchronous Counters**				
1.	Design, simulate, build, and test synchronous Mod counters using discrete gates to solve a problem.	MA5	2.5, 3.1, 3.2, 3.3	11:9-12P	K
2.	Design, simulate, build, and test synchronous Mod counters using an integrated counter chip in the solution to a design problem.	MA5	2.5, 3.1, 3.2, 3.3	11:9-12P	K
9.1	**Families and Specifications**				
1.	Interpret the graphs, charts, and written materials contained in a data sheet and apply it to a design problem.	CA3	1.5, 1.10	12:6-8H	L
10.1	**Microprocessors**				
1.	Formulate a flow chart to correctly apply basic programming concepts in the planning of a project.	CA4, MA5	1.8	12:9-12L	L
2.	Design and create a program, using correct syntax, to evaluate data and make decisions based on information gathered from the environment using external digital and analog sensors.	MA5	2.5, 3.1, 3.2, 3.3	11:9-12Q	M
3.	Create an interface to inspect, evaluate, and manage program parameters in the microprocessor during the operation of a program.	MA5	2.5, 3.1, 3.2, 3.3, 3.4	11:9-12Q	M
10.2	**Interfacing**				
1.	Design and create a program in correct syntax allowing a microprocessor to evaluate external data in order to operate motors and other devices to control the external environment.	MA5	2.5, 3.1, 3.2, 3.3	2:6-8M, 2:9-12FF	M
2.	Select, size, and implement interface devices to control external devices.	MA5	3.1	2:6-8P, 2:6-8V	M
3.	Design and create programming to control the position of stepper motors.	MA5	2.5, 3.1, 3.2, 3.3	2:9-12P	M