Curriculum Framework – Digital Electronics (2015-2016)
Unit 1 Foundation in Electronics – Lesson 1.1 Introduction to Electronics

Desired Results *(stage 1)*

ESTABLISHED GOALS
It is expected that students will…

- G1 – Demonstrate an ability to identify, formulate, and solve engineering problems.
- G2 – Demonstrate 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.
- G3 – Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data.
- G4 – Demonstrate an ability to apply knowledge of mathematics, science, and engineering.
- G5 – Demonstrate an ability to use the techniques, skills, and modern engineering tools

Transfer

TRANSFER: *Students will be able to independently use their learning to …*

- T1 – Model safe practices and procedures when working with electronics.
- T2 – Utilize scientific and engineering notation to represent large/small numbers and read the values of electrical components.
- T3 – Calculate, identify, and accurately measure characteristics of electrical circuits such as voltage, current, and resistance.
- T4 – Predict the characteristics and behavior of a circuit based on the orientation of components in relation to each other (Series and Parallel).
- T5 – Recognize and understand the function of common components utilized in electrical circuits and circuit designs.
- T6 – Translate between binary and decimal number systems.

Meaning

UNDERSTANDINGS: *Students will understand that …*

- U1 – Safety is an important concept that must be considered at all times. Safety considerations can affect the individual, class, and overall environment of the classroom/laboratory.
- U2 – Electricity, even at the nominal levels used in this curriculum, can cause bodily harm or even death.
- U3 – Engineers and technicians use scientific notation, engineering notation, and Systems International (SI) notation to conveniently write very large or very small numbers frequently encountered when working with

ESSENTIAL QUESTIONS: *Students will keep considering …*

- Q1 – Why are the safety considerations and best practices associated with working in electronics important?
- Q2 – How are calculations and measurement used to design and verify circuit characteristics?
- Q3 – What are the functions of the most common analog and digital components used in electronics?
- Q4 – What are the technical skills and processes that are utilized throughout electronics?

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necessary for engineering practice. • G6 – Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. • G7 – Demonstrate an understanding of professional and ethical responsibility. • G8 – Demonstrate an ability to function on multidisciplinary teams. • G9 – Demonstrate an ability to communicate effectively. • G10 – Gain knowledge of contemporary issues. • G11 – Recognize the need for, and develop an ability to engage in life-long learning.	electronics. • U4 – The concepts of voltage, current, and resistance are related to one another and can be calculated using circuit theory laws. • U5 – The series or parallel arrangement of components in a circuit affects current, voltage, and resistance across the component. These values can be calculated and verified through measurement. • U6 – Engineers utilize simulation and measurement instrumentation such as Circuit Design Software, Digital Multimeters (DMM), and oscilloscopes to verify designs and the functions of a circuit. • U7 – Resistors, capacitors, and light emitting diodes (LEDs) are common analog components in circuits. • U8 – Transistors, logic gates, flip-flips, and integrated circuits are all common digital components in circuits. • U9 – Combinational logic designs implemented with AND gates, OR gates, and INVERTER gates are referred to as AOI designs. • U10 – The flip-flop is the fundamental building block of sequential logic. • U11 – Logic gates are depicted by their schematic symbol, logic expression, and truth table. • U12 – Integrated circuits are categorized by their underlying circuitry, scale of integration, and packaging style. • U13 – Transistor-Transistor Logic (TTL) gates are available in a series of sub-families, each having their own advantages and disadvantages related to speed and power. • U14 – The binary number system and its relationship	

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	to the decimal number system is essential in the combinational logic design process. • U15 – Soldering is an important skill/process specifically related to working in electronics.	
	Acquisition	
	KNOWLEDGE: *Students will…* • K1 – Recognize safety hazards associated with electrical circuits and know the best practices of working safely in an electronics lab environment.U1,U2,U14 • K2 – Identify the equipment and know how to effectively use the equipment in an electronics lab.U1,U6,U14 • K3 – Know scientific notation, engineering notation, and System International (SI) notation.U3 • K4 – Know formulas for Ohm's Law, Kirchhoff's Voltage Law, and Kirchhoff's Current Law.U4,U5 • K5 – Know the characteristics of series and parallel sections of a circuit.U4,U5 • K6 – Identify digital and analog components and recognize the schematic symbol representation.U7,U8 • K7 – Know resistor color codes for labeling values.U7 • K8 – Know capacitor labeling codes.U7 • K9 – Know the characteristics of LEDs and how to locate LED datasheets.U7 • K10 – Recognize combinational logic gates.U9,U11 • K11 – Recognize sequential logic gates.U10,U11 • K12 – Recognize types of integrated circuits and know where to find manufacturer data sheets.U12,U13 • K13 – Relate schematic symbols to logic gates and	***SKILLS:*** *Students will…* • S1 – Practice proper safety and best practices while working with electronics.U1,U2 • S2 – Accurately take measurements with a Digital Multimeter (DMM).U6 • S3 – Express numbers in scientific notation, engineering notation, and System International (SI) notation.U3 • S4 – Solve for unknown values within circuits (series, parallel, and combination circuits) using Ohm's Law, Kirchhoff's Voltage Law, and Kirchhoff's Current Laws.U4,U5 • S5 – Utilize Circuit Design Software (CDS) and to validate hand calculations of analog circuit solutions.U6 • S6 – Identify and describe the function of common components used in electronics.U7,U8 • S7 – Demonstrate series and parallel circuits on a breadboard. U5 • S8 – Identify a resistor's nominal value by reading its color code. U7 • S9 – Measure a resistor's actual value by reading its resistance with a Digital Multimeter (DMM).U6,U7 • S10 – Identify a capacitor's nominal value by reading its labeled nomenclature.U7 • S11 – Identify commonly used electronic components given their part number or schematic symbol.U7,U8,U11,U12

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	logic gates to schematic symbols.U11 • K14 – Relate truth tables to logic gates and logic gates to truth tables.U11 • K15 – Know base 2 and base number systems.U6 • K16 – Know the best practices of soldering and de-soldering components.U14	• S12 – Obtain manufacturer datasheets and extract information for components commonly used in digital electronics.U11,U12,U13 • S13 – Identify various integrated circuit (IC) package styles. U11,U12,U13 • S14 – Recognize the fundamental differences between combinational and sequential logic.U8,U9,U10 • S15 – Identify and describe the function of AND, OR, and INVERTER gates.U9,U11 • S16 – Convert numbers between the binary and decimal number systems.U6 • S17 – Count from 0-15 in binary.U6 • S18 – Demonstrate proper soldering/de-soldering techniques to solder and de-solder components on a printed circuit board.U14 • S19 – Properly tin the tip of a soldering iron and distinguish good solder joints from bad solder joints.U14

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Evidence *(stage 2)*			Learning Plan *(stage 3)*	
Activities (A) Projects (P) Problems(B)	Assessment FOR Learning	Assessment OF Learning	Activities (A) Projects (P) Problems(B)	Student Knowledge and Skills
1.1.1.A General Safety	• Essential Questions	• Safety Quiz	1.1.1.A General Safety	K1,K2,S1
1.1.2.A Investigating Basic Circuits	• Essential Questions • Conclusion questions and guided discussions pre-activity and during activity	• Guided discussions post-activity • Demonstration of functioning circuit • Demonstration of precise voltage measurements	1.1.2.A Investigating Basic Circuits	K1,K2,K4,K5,K6,S1,S2,S4,S5,S6,S7
1.1.3.A Scientific & Engineering Notation	• Student responses to example conversions in presentation 1.1.3 Scientific & Engineering Notation. • Essential Questions	• Successful completion of conversions (20) • Conclusion Questions	1.1.3.A Scientific & Engineering Notation	K3,S3
1.1.4.A Component Identification: Analog	• Student responses to examples in presentation 1.1.4 Component Identification: Analog • Appropriate measurement technique demonstrated to instructor for reading resistance. • Essential Questions	• Successful identification of resistor/capacitor values conversions (20) • Conclusion Questions	1.1.4.A Component Identification: Analog	K1,K2,K3,K6,K7,K8,S1,S2,S3,S8,S9,S10
1.1.5.Aa Circuit Theory Laws: Calculations	• Student responses to examples in presentation 1.1.5	• Successful completion of hand calculation (12) • Conclusion Questions	1.1.5.Aa Circuit Theory Laws: Calculations	K3,K4,K5,K6,S3,S4

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	Circuit Theory Laws • Essential Questions			
1.1.5.Ab Circuit Theory Laws: Simulation	• Student demonstration that calculated values match simulated values. • Essential Questions	• Print out of simulated circuits with hand calculations (6). • Conclusion Questions	1.1.5.Ab Circuit Theory Laws: Simulation	K3,K4,K5,K6,S3,S5
1.1.5.Ac Circuit Theory Laws: Breadboard	• Essential Questions	• Demonstration of functioning circuit. • Conclusion questions	1.1.5.Ac Circuit Theory Laws: Breadboard	K1,K2,K4,K5,K6,K7,S1,S2,S3,SS5,S7
1.1.6.A Component Identification: Digital	• Student identifies circuit to truth table relationships accurately to instructor. • Student identifies I/O relationship of a flip-flop accurately • Student identifies capacitor/resistor relationships on frequency for the 555 timer. • Essential Questions	• Conclusion Question. • Print out of simulated circuits.	1.1.6.A Component Identification: Digital	K6,K10,K11,K12,K13,K14,S6,S11,S13, S14,S15
1.1.7.A Introduction to Datasheets	• Essential Questions	• Successful identification of digital components • Conclusion Questions	1.1.7.A Introduction to Datasheets	K6,K10,K11,K12,K13,K14,S6,S11,S12, S13,S14,S15
1.1.8.A Soldering: Fun Light (Optional)	• Instructor inspection of initial solder joints. • Essential questions	• Successful creation of the Fun Light circuit on the provided printed circuit board • Conclusion Questions	1.1.8.A Soldering: Fun Light (Optional)	K1,K2,K6,K7,K8,K15,S1,S8,S10,S18, S19

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1.1.9.P Soldering: Introduction to BGC	• Instructor inspection of initial solder joints. • Essential Questions	• Successful creation of the Random Number Generator circuit on the provided printed circuit board • Conclusion Questions

1.1.9.P Soldering: Introduction to BGC	K1,K2,K6,K7,K8,K10,K11,K12,K15,S1, S6,S8,S10,S11,S13,S14,S18,S19

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