Curriculum Framework – Digital Electronics (2015-2016)
Unit 1 Foundation in Electronics – Lesson 1.2 Introduction to Circuit Design

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

Transfer

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

- T1 – Recognize common analog and digital circuits. Identify and compare the characteristics of analog and digital circuits.
- T2 – Calculate, identify, and accurately measure characteristics of electrical circuits such as wavelength, period, and duty cycle.
- T3 – Characterize and troubleshoot circuits through calculations and measurements.
- T4 – Contrast analog circuits, combinational logic circuits, and sequential logic circuits. Explain how the fundamental building blocks of each give a circuit its desired function.
- T5 – Create circuits using a design process.
- T6 – Manipulate circuit designs to alter the characteristics of a circuit to desired outcomes.

Meaning

UNDERSTANDINGS: *Students will understand that …*

- U1 – Waveforms can be used to trigger events in a circuit.
- U2 – The concepts of frequency, wavelength, and duty cycle are all related to one another and can be calculated in a waveform.
- U3 – Analog and digital signals have different waveforms with distinctive characteristics.
- U4 – Analog signals have an infinite number of voltage levels that vary continuously over the voltage range for that particular system.
- U5 – Digital signals have two well-defined voltage

ESSENTIAL QUESTIONS: *Students will keep considering …*

- Q1 – How are the characteristics of digital circuits different than analog circuits?
- Q2 – Why is the understanding of binary and decimal number systems essential to your ability to design combinational logic circuits?
- Q2 – What might a design process look like for creating an analog or digital circuit?
- Q3 – How are calculations, computer software design (CDS) tools, and measurement tools used in electronics to guide development and troubleshoot a circuit?
- Q4 – Why is the 555 timer design such an important and

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to use the techniques, skills, and modern engineering tools 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.	levels, one for a logic high and one for a logic low. • U6 – Circuit design processes have evolved over time to create circuits. These processes have changed as new strategies and new technologies have become available. • U7 – Engineers and technicians use Circuit Design Software and instrumentation to verify functionality of their analog and digital design.	commonly used design in electronics?
	Acquisition	
	KNOWLEDGE: *Students will…* • K1 – Know formulas for Ohm's Law, Kirchhoff's Voltage Law, and Kirchhoff's Current Law.U6 • K2 – Know the characteristics of series, parallel, and combination circuits.U6 • K3 – Identify digital and analog components.U3,U4,U5 • K4 – Know the characteristics and differences between analog and digital signals and circuits.U1,U3,U4,U5 • K5 – Measure characteristics of a circuit using a DMM.U7 • K6 – Know the formulas for period, frequency, and duty cycle.U2 • K7 – Relate schematic symbols to logic gates and logic gates to schematic symbols.U6 • K8 – Relate truth tables to logic gates and logic gates to truth tables.U6 • K9 – Relate logic expressions to logic gates and logic gates to logic expressions.U6 • K10 – There is a formal design process for translating a set of design specifications into a functional circuit.U6	***SKILLS:*** *Students will…* • S1 – Solve for unknown values within circuits (series, parallel, and combination circuits) using Ohm's Law, Kirchhoff's Voltage Law, and Kirchhoff's Current Laws.U7 • S2 – Utilize Circuit Design Software (CDS) to validate hand calculations to analog circuit solutions.U7 • S3 – Demonstrate series and parallel circuits on a breadboard.U6,U7 • S4 – Analyze simple analog circuits using a digital multimeter.U8 • S5 – Analyze and interpret the amplitude, period, frequency, and duty cycle of analog and digital signals based on instrumentation and calculations.U1,U2,U3,U4,U5 • S6 – Interpret the design of a simple 555 Timer oscillator and how the analog components affect the wave generated.U1,U2,U3,U4,U5,U7 • S7 – Utilize the Circuit Design Software (CDS) to simulate and test a complete analog design.U1,U2,U3,U4,U5,U7 • S8 – Use Circuit Design Software (CDS) to simulate and test a simple combinational logic circuit designed with AND, OR, and INVERTER gates.U5,U7

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		• S9 – Identify and describe the function of a D flip-flop.U1,U2,U3,U5 • S10 – Use Circuit Design Software (CDS) to simulate and test a simple sequential logic circuit design with D flip-flops. U1,U2,U3,U5,U7 • S11 – Utilize the Circuit Design Software (CDS) to simulate and test a complete design containing both combinational and sequential logic.U6,U7

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Evidence *(stage 2)*		
Activities (A) Projects (P) Problems(B)	Assessment FOR Learning	Assessment OF Learning
1.2.1.A Introduction to Combinational Logic Design	• Essential Questions	• Student responses to examples conversions in presentation 1.2.1 Introduction to Combinational Logic Design. • Print out of simulated circuit • Conclusion Questions
1.2.2.A Analog and Digital Signals	• Essential Questions • Student demonstration of capturing a wave form trace	• Successful completion of calculations (4) • Print out of simulated circuit. • Conclusion Questions
1.2.3.A Binary Number Conversions	• Student responses to examples in presentation 1.2.3 Binary Number Conversions • Essential Questions	• Successful completion of conversions (30) • Conclusion Questions
1.2.4.A Sequential Logic Design	• Successful completion the frequency tables (3) • Essential Questions	• Student responses to examples in presentation 1.2.4 Sequential Logic Design • Print out of simulated circuit • Demonstration of functioning circuit
1.2.5.A Clock Signals: 555 Timer	• Successful completion the frequency table • Essential Questions	• Print out of simulated circuit • Demonstration of functioning circuit

Learning Plan *(stage 3)*	
Activities (A) Projects (P) Problems(B)	Student Knowledge and Skills
1.2.1.A Introduction to Combinational Logic Design	K3,K5,K7,K8,K9,K10,S5,S10
1.2.2.A Analog and Digital Signals	K3,K4,K5,K6,S4,S5,S9
1.2.3.A Binary Number Conversions	K15,K16,S16,S17
1.2.4.A Sequential Logic Design	K3,K4,K5,K6,K10,S5,S11,S12
1.2.5.A Clock Signal: 555 Timer	K1,K2,K3,K4,K5,K6,K10,S1,S2,S3, S4,S5,S6,S7

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1.2.6.A Understanding Analog Design: The Random Number Generator	• Student responses to examples in presentation 1.2.6 Understanding Analog Design: The Random Number Generator • Essential Questions	• Conclusion Questions	1.2.6.A Understanding Analog Design: The Random Number Generator	K1,K2,K3,K4,K5,K6,K10,S1,S2,S3, S4,S5,S6,S7
1.2.7.A Understanding Digital Design: The Random Number Generator	• Student responses to examples in presentation 1.2.7 Understanding Digital Design: The Random Number Generator • Essential Questions	• Print out of simulated circuit • Conclusion Questions	1.2.7.A Understanding Digital Design: The Random Number Generator	K3,K4,K6K7,K8,K9,K10,S8,S9,S10, S11

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