**SOUTHEAST COMMUNITY COLLEGE**
**CONSTRUCTION MANUFACTURING AND TECHNOLOGY DIVISION**
**Electronic Systems Technology Program**
**Revision Date: August 22, 2022**

## I. CATALOG DESCRIPTION

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|---|---|
| Course Number: | ELEC1245 |
| Course Title: | Digital Systems |
| Prerequisite(s): | ELEC1130 or ELEC1131 |
| Catalog Description: | This course is structured to provide a comprehensive understanding of digital systems. The material covered in this course includes digital number systems, codes, arithmetic, logic gates, combinational, and sequential logic circuits. Additional topics include interfacing, communications, and other applications with digital devices. Digital Systems also covers programming techniques using an integrated development environment utilizing Field Programmable Gate Arrays (FPGA). |
| Credit Hours: | 6 |
| Class Hours: | 68 |
| Lab Hours: | 68 |
| Total Contact Hours: | 136 |

## II. COURSE OBJECTIVES: *Course will:*

- **A.** Analyze the operation of basic logic gates, combinational and sequential logic circuits.
- **B.** Formulate numbering systems including Binary, Hexadecimal, ASCII, and BCD.
- **C.** Examine digital arithmetic using various number systems.
- **D.** Examine and illustrate interfacing Digital and Analog circuits.
- **E.** Describe the differences between Microprocessors, Field Programmable Gate Arrays and Microcontrollers.
- **F.** Program an FPGA with an integrated development environment.

## III. STUDENT LEARNING OUTCOMES AND GENERAL EDUCATION LEARNING OUTCOMES:

**A.** Student Learning Outcomes: *Student will be able to:*

1. Describe the fundamentals of digital electronics devices.
2. Demonstrate the ability to perform conversions between different numbering systems.
3. Identify digital code systems such as ASCII, BCD, and Gray.
4. Demonstrate the ability to perform arithmetic operations using binary and hexadecimal number systems.
5. Explain basic logic operations such as AND, OR, XOR, NOT, NAND, NOR.
6. Demonstrate the ability to develop combinational logic circuits.
7. Simplify a logical expression or circuit using Boolean and Karnaugh mapping.
8. Describe Flip Flop construction and operation.
9. Design and build sequential circuits using flip flop for applications such as counting and registers.
10. Demonstrate the principles of interfacing logic circuits to other circuits.
11. Build and demonstrate digital system operations using logic devices to include Multiplexers, demultiplexer, encoders, and decoders.
12. State the fundamentals of analog to digital and digital to analog conversion.
13. Build and demonstrate A-D and D-A circuits.

14. Describe the differences between microprocessors, microcontrollers, and FPGAs.
15. Demonstrate how a FPGA functions using a FPGA Device.
16. Write programs to implement digital logic using a Hardware Development Language.
17. Program a FPGA device using an integrated development environment.

B. General Education Learning Outcomes (GELOs)
1. GELO #3: Critical Thinking & Problem Solving
Outcome 2: Synthesize information to arrive at reasoned solutions to problems.
2. GELO #5: Analytical, Quantitative, and Scientific Reasoning
Outcome 2: Understand and create logical arguments supported by quantitative and scientific evidence and communicate those arguments in a variety of formats.

## IV. CONTENT/TOPICAL OUTLINE

A. Introduction to Digital Concepts
1. Digital vs. analog
2. Digital concepts introduced
   a. Logic levels
   b. Digital signals

B. Number Systems and Codes
1. Decimal
2. Binary
3. Hexadecimal
4. Binary coded decimal numbers (BCD)
5. Binary addition and subtraction
6. ACSII

C. Basic Gates
1. Boolean Logic Introduction
2. Creating Truth tables
3. Basic Digital Gates
4. Other digital Gates

D. Combinational Logic Circuits
1. Boolean constant and variables
2. Boolean Expressions
3. Combinational logic circuit
4. Develop circuits from Boolean expressions

E. Simplifying and Design of Combinational Logic Circuits
1. Boolean and DeMorgan's Theorems
2. SOP expression
3. Circuit simplification techniques
   a. Boolean algebra simplification
   b. Karnaugh Map simplification
4. Combinational Logic Circuit Design

F. Digital Logic Devices
1. Microprocessor
2. Microcontroller
3. PLD-FPGA

G. Sequential Logic Circuits
1. Flip Flops
2. Counting
3. Registers

H. Interfacing Integrated Circuits

1. Interfacing Integrated circuit families
2. Open collector
3. Tristate and bidirectional devices
4. Bus Lines

I. Digital Circuit Operations
1. Encoders
2. Decoders/Drivers
   a. Displays
3. Multiplexing
   a. Communication
4. Demultiplexing

J. Analog Interfacing
1. Digital to analog conversion
2. Analog to digital conversion

K. Memory Devices
1. Memory Terminology
2. Architectures
3. Types

## V. INSTRUCTIONAL MATERIALS

**A.** Required Text(s): Tocci, Ron J., Widmer, Neal, and Moss, Gregory, *Digital Systems,* (Refer to CID and/or instructor for current edition)

**B.** Other Resources: Multi-SIM, DE10 Lite FPGA Kit

**C.** Outside Reading/Research Required: Assigned by Instructor

**D.** Supplies: Notebook, Calculator, Colored pen and/or pencils and Large breadboard or (2) small breadboards, flash drive

## VI. METHODS OF PRESENTATION/INSTRUCTION

**A.** Methods of presentation typically include a combination of the following:
1. Technology enhanced lecture
2. Classroom discussion
3. Interactive group activities
4. Audio visual materials
5. Presentation by experts for the Electronics and Networking industry

## VII. METHODS OF EVALUATION

**A.** Methods of evaluation, although determined by the individual instructor, traditionally includes a combination of the following:
1. Attendance and participation
2. Daily assignments
3. Written exams and /or quizzes
4. Performance and observational assessment

## VIII. SPECIFIC COURSE REQUIREMENTS

**A.** A minimum grade of 60% is required.

**B.** Credit by Examination: Credit for the course CANNOT be earned through Credit by Examination.