Course Description

CET1110C | Digital Circuits | 4.00 credits

This course is intended for students majoring in Electronics or Computer Engineering Technology. Students will learn how to apply electronic principles to digital computer circuits and systems. Students will also learn how to simplify logic circuits, build digital circuits, and perform other laboratory activities. Prerequisite: EET1015C, MAC1105. Pre/ corequisite: COP2270.

Course Competencies:

Competency 1: The student will demonstrate the ability to define and apply numbering systems to codes and arithmetic operations by:

1. Explaining the difference between the decimal and binary numbering systems
2. Using the binary number system to count, add, subtract, multiply, divide, and perform decimal-to-binary and binary-to-decimal conversions
3. Using the hexadecimal and octal system to count and perform conversions to and from decimal and binary systems
4. Using signed numbers and complements to perform addition and subtraction using the one's and two’s complements

Competency 2: The student will demonstrate an understanding of digital electronic signals and switches by:

1. Describing the parameters associated with digital voltage-versus-time waveforms
2. Converting between frequency and period for a periodic clock waveform
3. Sketching the timing waveform for any binary string in either serial or parallel representation
4. Discuss the application of manual switches and electromechanical relays in electric circuits
5. Explain the basic characteristics of light-emitting diodes that are forward/reverse biased
6. Calculating the output voltage in an electric circuit containing diodes or transistors operating as digital switches
7. Performing timing analysis in switching circuits

Competency 3: The student will demonstrate the ability to analyze and minimize logic circuits using Boolean operations by:

1. Using logic gates to perform addition, logical multiplication, second and higher-order logic, and complementing
2. Applying fundamental theorems, associative laws, distributive laws, commutative laws, and De Morgan’s theorems to solve problems
3. Applying Boolean principles to perform logic circuit evaluation using truth tables, simplifying by fundamental theorems, and simplifying by the Karnaugh map technique
4. Minimizing logic circuits into a sum of products (SOP) and product of sums (POS) form

Competency 4: The student will demonstrate an understanding of basic logic circuits by:

1. Identifying and constructing circuits using the basic logic gates (NOT, OR, AND, NOR, NAND) and their truth tables
2. Identifying and constructing circuits using the compound logic gates (EXOR, EXNOR) and their truth tables
3. Identifying and constructing adder/subtractor logic circuits
4. Troubleshooting adder/subtractor logic circuits
5. Describing the operation, uses, and applications of mono-stable and a-stable multi-vibrators
6. Using logic probes, power supplies, pulse generators, and oscilloscopes to analyze and test digital logic circuits
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circuits

Competency 5: The student will demonstrate an understanding of complex digital circuits by:

1. Constructing combinatorial logic circuits
2. Utilizing an integrated circuit (IC) magnitude comparator to perform binary comparisons
3. Describing the function of a decoder and an encoder
4. Locating and utilizing manufacturers' data
5. sheets to determine the operation of logistics
6. Explaining the procedure involved in binary, BCD (binary coded decimal), and Gray code converting
7. Identifying types of encoding, decoding, multiplexer, and de-multiplexer devices and describing their functions and uses

Competency 6: The student will demonstrate an understanding of flip-flops, registers, counters, and state machines by:

1. Explaining the internal circuit operation of S-R (set/reset) and gated S-R flip-flops
2. Comparing the operation of D (data) latches and D flip-flops by using timing diagrams
3. Describing the difference between pulse-triggered and edge-triggered flip-flops
4. Explaining the theory of operation of master-slave devices
5. Connect IC J-K flip-flops as a toggle and D flip-flops
6. Identifying and constructing various types of registers and counters
7. Analyzing sequential circuits such as ripple counters, divide-by-N counters, and synchronous counters
8. Designing, Analyzing, and Constructing finite state machines and counters using discrete integrated circuit (IC) logic devices

Course Competency 7: The student will demonstrate an understanding of the logic families by:

1. Locating and determining IC input, output voltage, and current ratings from the manufacturer's data manual
2. Discussing the differences and proper use of the various subfamilies within both the TTL (transistor logic) and CMOS (complementary metal oxide semiconductor) lines of IC's
3. Describing the reasoning and various techniques for interfacing between the TTL, CMOS, and ECL (emitter-clamped logic) families of ICs

Course Competency 8: The student will demonstrate an understanding of the practical considerations for digital design by:

1. Describing the causes and effects of race conditions in synchronous flip-flop operation
2. Using the manufacturer's datasheet to determine IC operating specifications, such as setup time, hold time, propagation delay, and input/output voltage and current specifications
3. Performing worst-case analysis on the time-dependent operations of flip-flops and sequential circuitry.
4. Designing a series RC circuit to provide an automatic power-up reset function
5. Describing the wave-shaping capability and operating characteristics of Schmitt trigger ICs
6. Describing the problems caused by switch bounce and how to eliminate its effects
7. Calculating the optimum size for a pull-up resistor

Course Competency 9: The student will demonstrate an understanding of the practical considerations for Electrostatic Discharge (ESD) by:

1. Explaining how static electric charges occur
2. Identifying the damaging voltage levels within ESD
3. Detecting ESD in sensitive equipment and components
4. Reviewing ESD standards set forth by the Electrostatic Association
5. Discussing and implementing industry-standard ESD procedures and equipment

6. Identifying and interpreting industry-standard symbols for ESD
7. Applying ESD procedure in the classroom environment
8. Using ESD methods to prevent damage to lab components and laboratory equipment
9. Observing ESD prevention practices when handling CMOS integrated circuits

Course Competency 10: The student will demonstrate an understanding of input and output devices by:

1. Explaining the operation of binary-weighted and R.2R digital-to-analog converters
2. Explaining the external connections to a digital-to-analog IC to convert a numeric binary string into a proportional analog voltage
3. Explaining the operation of parallel-encoded, counter ramp, and successive-approximation analog-to-digital converters
4. Discussing the operation of a typical data acquisition system

Learning Outcomes:

- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning
- Use computer and emerging technologies effectively