1. ECE 2140 – Introduction to Digital Systems
2. Course credit hours: 4
   Contact hours per week: 6 (lecture: 3, lab: 3)
   Credit category: Engineering Topics

3. Course Instructor: Dr. Mohamed Mahmoud

4. Textbook: *Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog, 6/e*, M.M.R. Mano and M.D. Ciletti, Pearson, 2018.

   Digital Design, zyBooks (www.zybooks.com)

   Supplemental materials:
   N/A

5. Course information:

Catalog description	Analysis and design of digital systems. Number systems; Boolean algebra; combinational and sequential logic circuits; state machine design; register-transfer level design; memory organization; and introduction to digital hardware design and field-programmable gate arrays.
Prerequisite(s)	C or better in MATH 1910 (MATH 1910 may be taken concurrently)
Course type	Required Course for EE, EE-Mech, EE-VE, CMPE

6. Course instructional outcomes:

Course Outcome No.	Course Outcome (CO)	ABET Student Outcome
CO1	Explain the difference between combinational and sequential networks.	SO2
CO2	Determine, transform, and operate on integer and fractional numeric values in a given radix	SO2
CO3	Describe the logical operation of and use of standard combinational and sequential logic blocks, including logic gates, CMOS logic gates, decoders, encoders, multiplexers, demultiplexers, adders/subtractors, comparators, and ALUs, registers, shift-registers, counters.	SO2
CO4	Apply the laws of Boolean algebra to the manipulation and simplification of algebraic expressions.	SO2
CO5	Convert a logic function between various forms, including truth table, conjunctive and disjunctive normal forms, and simplified Boolean equation forms.	SO2
CO6	Use K-maps and other methods to obtain optimal sum-of-products or product-of-sums of a logic function.	SO2

CO7	Analyze a given combinational logic schematic to determine its function.	SO2
CO8	Given a word description of a logic function, design and document (via schematic, timing diagram, truth table, and a variety of Boolean equation forms) a minimal logic implementation using standard logic gates and components.	SO2
CO9	Explain the operation and proper uses of standard sequential primitives and blocks: D and SR latches, D, T, SR, JK flip-flops, registers, shift-registers, counters, and PLDs such as FPGA	SO2
CO10	Determine temporal behavior given a sequential circuit schematic, finite state machine transition table, finite state machine diagram.	SO2
CO11	Draw a state diagram of a given sequential function, and design the corresponding sequential circuit.	SO2
CO12	Utilize a top-down modular design process to complete a medium complexity combinational-sequential logic design project that meets given certain design constraints.	SO1, SO2, SO3, SO5
CO13	Effectively use digital laboratory test equipment.	SO5, SO6
CO14	Measure the electronic and logical characteristics of logic devices.	SO6
CO15	Construct, design and test combinational and sequential logic circuits using appropriate techniques.	SO1, SO2, SO5
CO16	Write technical reports.	SO3

ABET criterion 3 Student Outcomes addressed by this course:

SO No.	Student Outcome (SO)
SO1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
SO2	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
SO3	An ability to communicate effectively with a range of audiences.
SO5	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

7. Course topics:
    1. Course Introduction (5%)
    2. Number systems and codes (10%)
    3. Boolean algebra (15%)

4. Combinational logic design (20%)
5. Latches, flip-flops, analysis and design of sequential logic circuits (25%)
6. Project Design (5%)
7. Test and solutions (15%)
8. Introduction to digital test equipment (Lab; 10%)
9. Physical characteristics of digital logic: propagation delay, rise/fall times, voltage and current characteristics, noise margins, and unused pins (Lab; 10%)
10. Construction and testing of combinational logic circuits (Lab; 30%)
11. Design and test of combinational and sequential logic using logic gates, logical blocks, and modern PLDs, such as FPGAs (Lab; 25%)
12. Project implementation (Lab; 25%)

Program criteria (curriculum) addressed by this course:

1. …engineering topics necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.
2. …discrete mathematics.

8. Additional topics, assignments, or requirements for dual-level (4000/5000) course:
   N/A

9. Revision Date: 02/02/2022