CS 354: Digital Systems Design

1. Course number and name: CS 354: Digital Systems Design

2. Credits and contact hours: 3.000 Credit Hours, 3.000 Lecture hours

3. Instructor or course coordinator: Zdravko Markov


   a. other supplemental materials
      - Course syllabus and lecture notes are available on line at http://www.cs.ccsu.edu/~markov/ccsu_courses/354Syllabus.html
      - The course uses Blackboard/Vista for projects, quizzes, and grade book.

5. Specific course information

   a. brief description of the content of the course (Catalog Description):
      An introduction to the analysis and design of digital systems in terms of logical and sequential networks. Various minimization techniques are studied.

   b. prerequisites or co-requisites: CS 254 and MATH 218. PHYS 338 must be taken concurrently by those students whose program requires PHYS 338.

   c. indicate whether a required, elective, or selected elective course in the program: Required

6. Specific goals for the course

   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.

      Upon successful completion of the course the student will be able to:

      - Understand the basics of Boolean algebra
      - Use minimization techniques to implement Boolean functions by logic gates
      - Implement combinational circuits as adders, multiplexers, encoders and decoders
      - Understand the basics of synchronous sequential logic and finite state machines
      - Implement clocked sequential circuits as registers, counters and memory devices
      - Use a digital simulator and the hardware description language (HDL) to implement digital circuits
      - Implement simple ALU and CPU

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
The course outcomes will allow students taking CS354 to make progress toward the following department outcomes:

- **Outcome a**: An ability to apply knowledge of computing and mathematics appropriate to the discipline
- **Outcome b**: An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
- **Outcome c**: An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.
- **Outcome i**: An ability to use current techniques, skills, and tools necessary for computing practice.
- **Outcome j**: An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.

7. Brief list of topics covered

1) Boolean Algebra
   a) Basic axioms and theorems, Boolean functions
   b) Canonical and standard form of Boolean functions
   c) Algebraic simplification of Boolean functions
2) Implementation of Boolean functions in logic gates
   a) Map method for simplification of Boolean functions
   b) NAND and NOR implementation of Boolean functions
3) Combinational logic
   a) Adders, subtractors, decoders, encoders, multiplexers, ROM, and PLA
   b) Simple ALU and CPU
   c) Using Verilog HDL to design combinational circuits
4) Clocked sequential circuits
   a) Finite state machines, Turing machines
   b) Registers, counters and memories

8. Expected Performance Criteria

Students will demonstrate their mastering of digital design concepts in written answers to questions on two tests and a final exam, which include both theory (Boolean algebra, finite state machines) and problems on analysis and design of digital circuits. The student’s ability to design digital circuits by given specifications will be demonstrated in three major projects. The first project requires designing, simulating and testing a number of digital circuits by using a digital simulator and Verilog HDL. The second and the third projects involve designing a simple Arithmetic Logic Unit (ALU) a complete 4-bit Central Processing Unit (CPU).