Fall 2013

CEG 3320-01: Digital System Design

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WRIGHT STATE UNIVERSITY
Wright State University
College of Engineering and Computer Science
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Digital System Design

CEG 3320

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Course Description: Basics of Digital Computer Hardware and Design. Topics include switching algebra and switching functions, logic design of combinational and sequential circuits, storage elements, register-level design, and instrumentation. 3 hours lecture, 1 credit hour lab.

Prerequisites: College-level familiarity with programming languges (CS 1180 Computer Science I or CS 1160 Intro to Computer Prog or CEG 2170 Intro to C Prog) AND College-level mathematical readiness (MTH 1280 College Algebra OR MTH 1340 Precalculus OR WSU Math Level MPL 05).

Objectives: This course has two primary objectives. The first is content-based. We hope to teach students the fundamental principles of design for sequential digital devices. The second objective is skill-based. Students will exercise their ability to apply these principles in practical application though laboratory projects. At the end of this course, each passing student should be able to:

- **CE-DIG1 Switching theory**
- 1. Work with binary number systems and arithmetic.
- 2. Derive and manipulate switching functions that form the basis of digital circuits.
- 3. Reduce switching functions to simplify circuits used to realize them.

- **CE-DIG2 Combinational logic circuits**
- 1. Realize switching functions with networks of logic gates.
- 2. Explain and apply fundamental characteristics of relevant electronic technologies, such as propagation delay, fan-in, fan-out, and power dissipation and noise margin.

- **CE-DIG3 Modular design of combinational circuits**
- 1. Analyze and explain uses of small- and medium-scale logic functions as building blocks.
- 2. Analyze and design combinational logic networks in a hierarchical, modular approach, using standard and custom logic functions.

- **CE-DIG4 Memory elements**
- 1. Design and describe the operation of basic memory elements.
- 2. Analyze circuits containing basic memory elements.

- 3. Apply the concepts of basic timing issues, including clocking, timing constraints, and propagation delays during the design process.

- **CE-DIG5 Sequential logic circuits**
- 1. Analyze the behavior of synchronous machines.
- 2. Synthesize synchronous sequential machines.

- **CE-DIG6 Digital systems design**
- 1. Apply digital system design principles and descriptive techniques.
- 2. Analyze and design functional building blocks and control and timing concepts of digital systems.
- 3. Develop a complex digital system design in a hierarchical fashion using top-down and bottom-up design approaches.
- 4. Utilize programmable devices such as FPGAs and PLDs to implement digital system designs.

- **CE-DIG7 Modeling and simulation**
- 1. Model and simulate a digital system using schematic diagrams.
- 2. Understand timing issues in digital systems and know how to study these via digital circuit simulation.

Intensive writing: This course requires the maintaince of a laboratory/engineering notebook. In this courses, students are expected to produce writing that:

- Demonstrates their understanding of course content,
- Is appropriate for the audience and purpose of a particular writing task,
- Demonstrates the degree of mastery of disciplinary writing conventions appropriate to the course (including documentation conventions), and
- Shows competency in standard edited American English.

Textbook: Every student should have access to *some* reference textbook or material to supplement the lecture instruction. As taught, this course does not *require* any specific textbook. Students are free to use any contemporary textbook or on-line resource to supplement the material discussed in lecture and laboratory. Several copies of contemporary textbooks are available in the laboratory for student use. Chapter/sections for lecture material will be provided only for the most current edition of the *recommended* textbook.

Recommened: Vahid, Frank. "Digital Design", any edition, John Wiley and Sons.
Reference: Mano, Morris and Kime, Charles. "Logic and Computer Design Fundamentals", any edition, New Jersey: Prentice-Hall.

Grading: A student's demonstration of their ability to discuss issues, solve problems, and demonstrate mastery of digital design will be the underlying metric for the determination of a student's overall grade in this course. Students will be provided the opportunity to demonstrate their mastery through examinations and laboratory projects. Grades will be assigned on a standard A/90%, B/80%, C/70%, D/60%, F/60%- scale. Clustering of grades may cause the thresholds to be lowered; they will not be raised. The instructor reserves the right to fail any student who does not a student attain both a passing grade (70%+) in the laboratory and at least a grade of 50% on the final. The overall course grade will be the weighted sum of the three grades: