SE 311: Digital Systems Design (2-3-3)

Term 041

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(see also the WebCT site for the course)

Office hours: Sun and Tue, 11:20-12:50 , or by appointment

Catalog Description:	Binary arithmetic. Boolean Algebra. Boolean functions and their simplification. Implementation of Boolean functions using Logical Gates. SSI, MSI, and LSI chips. Analysis and Design of Combinational circuits. Sequential Logic: Flip-Flops, Counters, and Registers. Analysis and Design of sequential circuits. Basic elements of digital Computers: Register-transfer, Micro operations, Instruction codes, Processor organization Arithmetic Logic Unit.
Prerequisite:	EE 203
Textbook:	M. Morris Mano, Digital Design, Prentice-Hall,3nd edition, 1991.
Goals:	To introduce the fundamental concepts of digital logic, including analysis and design of combinational and sequential circuits.

COURSE OUTCOMES

At successful completion of this course the student will be able to:

- Convert between decimal, binary, octal and hexadecimal numbers.
- Perform addition and subtraction in the four bases studied (10, 2, 8, and 16). Use various codes, ex. ASCII, gray code, BCD, etc.
- Derive and simplify Boolean expressions.
- Use a wide range of digital chips, from simple AND, OR, NOT, NAND and NOR gates to adders, subtractors, decoders, and multiplexers.
- Identify basic flip-flop types (D, T, S-R and J-K) and clocking variations (edge-triggered, master-slave, and transparent). Interpret timing diagrams of flip-flops.
- Analyze circuits derived from flip-flops, ex. counters and shift registers.
- State basic differences between TTL and CMOS.
- Build, test, and troubleshoot digital circuits.
- Use a software package to analyze and design simple digital circuits.

Topics:

1. Binary Systems (2 classes).
2. Boolean Algebra and Logic Gates (4 classes)
3. Simplification of Boolean Functions (4 classes) .
4. Combinatorial Logic (3 classes).
5. Combinatorial Logic with MSI and LSI (4 classes).
6. Synchronous Sequential Logic (6 classes).
7. Registers, Counters, and the Memory Unit (4 classes).
8. Asynchronous Sequential Logic (3 classes).

Grading Policy:

Attendence & Homework	**8%**	
Major Exam 1	**15%**	
Major Exam 2	**20%**	
Quizzes	**12%**	
Lab and project	**20%**	
Final	**25**	

Laboratory projects:

1. Introduction to digital design: Functions of AND, OR, NOR, and NAND gates. Each student has his own breadboard, wires, circuits, and power supply.
2. Analysis and design of Boolean functions: use of TTL circuits; 7400, 7401, 7402, 7403, 7404, 7405, 7408, 7409, and 7410.
3. Simplification of Boolean functions: Design of some simplified functions using TTL integrated circuits, and verification of the corresponding logic tables.
4. Design of Boolean functions with multiple outputs.
5. Combinatorial circuits: Design of a parallel adder, subtractor, comparator by using TTL circuits. Use of MSI and LSI integrated circuits, decoders, and multiplexers to design Boolean functions.
6. Sequential circuits: Design based on clocked JK flip-flops, D flip-flops, and RS flip-flops. Use of TTL circuits: 7475, 7476, 7477, and 7478 to design synchronous sequential circuits.
7. Use of flip-flops to design binary up-down counters, serial shift registers, and serial adders.
8. Design of asynchronous sequential circuits by using TTL flip-flop circuits.