

ECE241F - Digital Systems - Course Outline

Fall 1999

A. Carusone, P. Lehn, J. Rose

Goals

- understand basic digital logic circuit design and concepts
- become comfortable with CAD tools in design
- hands-on experience with design and debug of systems, using programmable logic

1.0 Introduction to Combinational Logic

- motivation
- switches and logic gates
- logic functions, truth tables and variables
- boolean axioms and laws, sum of products, product of sums
- simple algebraic minimization - making things cheaper

2.0 Technology

- logic voltage levels
- transistors as a switch
- NMOS and CMOS logic gates
- real propagation delay, and timing diagrams
- TTL Logic, PALs, and Complex Programmable Logic Devices (CPLDs)
- introduction to VHDL (a language for describing hardware) and CAD tools that implement hardware given the VHDL description

3.0 Combinational Logic Optimization

- minimization goals - speed and cost
- Karnaugh Maps
- Don't Cares
- multi-level logic optimization
- critical path

4.0 Sequential Logic

- cross-coupled NOR gates basic latch
- gated latch
- Master-Slave D flip-flop

- shift registers
- counters
- Set-up & Hold time, Clock-to-Q

5.0 Finite State Machines

- how logic is controlled
- state diagrams
- Mealy/More State Machines
- State machine synthesis
- State machines in VHDL
- state encoding and optimization

6.0 Numbers and Arithmetic

- number representation, binary, ones & twos complement representation of negative numbers
- basic adder/subtractor
- carry lookahead fast adder
- bit serial addition
- multiplier

7.0 Miscellaneous

- multiplexors & tristate gates
- multiplexors as logic; decoders
- fanout dependent delay
- power dissipation, I/O devices and FPGAs