This course covers concepts of VLSI Design with emphasis on circuit and system design, optimization, and layout for very high speed, high density, or low power system applications. Special attention is devoted to the impact of scaling, deep submicron effects, interconnect, signal integrity, power distribution and consumption, and timing. This is a graduate level project-oriented course in which students design a simple digital/computer system. Extensive use of CAD tools is required.

Prerequisites: Students are expected to have working knowledge of logic design, elementary circuits and basic device physics. Background in computer architecture is helpful, but not required.

Topics

1. Fundamentals –Reference Chapter 3
   1.1 Overview of the MOSFET device.
   1.2 Static and Dynamic behavior.

2. Interconnects (the wire) –Reference Chapters 4 & 9
   2.1 Capacitance and its effect on interconnects
   2.2 Resistance and Inductance.
   2.3 Interconnection models (RC Delays)

3. CMOS inverter –Reference Chapter 5
   3.1 Static CMOS, CMOS Inverter, transistor sizing, buffer design.
   3.2 Dynamic behavior
   3.3 Power energy and delay

   4.1 Static CMOS logic gates.
   4.2 Dynamic logic gates and design.

5. Sequential Logic Circuits –Reference Chapter 7
   5.1 Flip-flops.
   5.2 Dynamic Circuits.
   5.3 Clock approaches.

6. Timing –Reference Chapter 10
   6.1 Timing analysis, flip-flop/latch design.
   6.2 Clock skew, clocking techniques, self-timed design.
   6.3 Clock generation and distribution.

7. Arithmetic building blocks –Reference Chapter 11
   7.1 Binary addition and adders.
   7.2 Binary multiplication and multiplier array.

8. Memory design –Reference Chapter 12
   8.1 Memory architecture and building blocks.
   8.2 Programmable Logic Array (PLA).


Grade: 2 Exams (25% each) 50%
        Project 30%
        Homework 20%