San Francisco State University
School of Engineering

ENGR 848: Digital VLSI Design

Fall 2008

Instructor: Hamid Mahmoodi
Office: SCI 213-A Email: mahmoodi@sfsu.edu Phone: 415-338-6579

I. Course Aims and Objectives:

Aims

This course is designed to teach students the analysis and design of Very Large Scale Integrated Circuits (VLSI). The course begins with the fundamentals of digital IC design and small circuits such as logic gates and then moves towards more complex circuits such as arithmetic units and memory circuits. The skills learned in this course will prepare students to do real-world design tasks or do research in various areas of VLSI and circuit design.

Specific Learning Objectives:

By the end of this course, students will be able to:

- Describe fundamental metrics used for quantitative evaluation of a design
- Explain basics of MOS transistors and CMOS technology
- Describe silicon technology scaling and trends
- Design using different logic styles such as complementary CMOS logic, pass-transistor logic, dynamic logic, etc
- Have the skill of transistor-level analysis and design of simple and complex logic gates such as inverter, NOR and NAND gates
- Explain different memory elements and design sequential logic circuits such as latches and flip-flops
- Consider the role of interconnects in IC design
- Design arithmetic functional units such as adders and multipliers
- Design memory (SRAM and DRAM)

II. Prerequisite:

Basic knowledge of logic circuits and digital electronics (Familiarity with MOS transistor and CMOS technology is a plus).

III. Textbooks:

Primary textbook:

1) Digital Integrated Circuits (2nd Edition) by Jan Rabaey et.al., Prentice Hall, 2003

Optional textbooks:

2) CMOS VLSI Design: A Circuits and Systems Perspective (3rd Edition), by Neil H.E. Weste, David Harris

3) Principles of CMOS VlSI Design, by Neil H. E. Weste, Kamran Eshraghian

IV. Topics:

1. Introduction to digital integrated circuits
2. Design metrics
3. MOS transistor
4. CMOS technology
5. CMOS inverter
6. Interconnects
7. Combinational logic gates in CMOS
8. Design of sequential logic circuits
9. Arithmetic building blocks
10. Memory design

V. Course Project

As a course project students are required to form teams of no more than two students, and custom design a 4-bit ripple carry adder in an advanced CMOS technology. The design will be done using EDA tools for integrated circuit design and simulation. The design needs to be characterized in terms of speed, power, and layout area. The design that has the least power, area, and delay will be the winning project. These performance criteria (power, area, and delay) will be used to grade projects.

VI. Grading Policy:

1 mid-term exam accounting for 30% of the grade
Final exam accounting for 30% of the grade
Project accounting for 30% of the grade
Homeworks accounting for 10% of the grade

VII. Accommodations for students with disabilities:

The Disability Program and Resources Center provides university academic support services and specialized assistance to students with disabilities. Students in need should contact Services for Students with Disabilities (SSB 110, 338-2472) for information regarding accommodation. Please notify your instructor so that reasonable efforts can be made to accommodate you.