ENG EC571 VLSI Principles and Applications

2008/2009Catalog Data:
ENG EC 571 Very large-scale integrated circuit design. Review of MOSFET basics. Functional module design, including BiCMOS, combinational and sequential logic, programmable logic arrays, finite-state machines, ROM, and RAM. Fabrication techniques, layout strategies, scalable design rules, design-rule checking, guidelines for testing and testability. Analysis of factors affecting speed of charge transfer, power requirements, and control and minimization of parasitic effects. Survey of VLSI applications. Extensive CAD laboratory accompanies course. 4 cr.

Status in the Curriculum: Elective

Class/Lab Schedule:
LEC: 4 hrs/wk

Textbooks: (Not required, but we will order as many as needed)
"Digital Integrated Circuits: A Design Perspective, Second Edition, Rabaey, Chandrakasan, and Nikolic, Prentice Hall.

Other References:
"CMOS Digital Integrated Circuits," Sung-Mo Kang and Yusuf Leblebici, (McGraw Hill)
"Principles of CMOS VLSI Design: a systems perspective", Neil Weste, Kamran Eshraghian (Addison-Wesley)

Coordinator:
Allyn E Hubbard, Professor, ECE Department

Prerequisites by topic:
EC311 (essential) & EC410 (not essential): Elementary logic design, Introduction to electronic devices.

Goals:
To provide students with:

- Extensive training in the design of CMOS integrated circuits that perform an arbitrary digital function and meet an arbitrary performance specification.
- Become proficient with a VLSI CAD tool.
- Understanding of how to keep pace with the field as it crosses into "new territory" over the next few years.

Course Outcomes:

As an outcome of completing this course, students should be able to:

1) Understand the MOSFET basics and their fabrication and the layout design rules.
2) Understand the operation of MOS transistor.
3) Understand the static characteristics of MOS inverters.
4) Design, implement and test: Inverter Sizing and Noise Margin Calculation.
5) Understand the switching characteristics and interconnect effects of MOS inverters.
6) Understand the implications of internal and external loading.
7) Design, implement and test: Buffer Chains used to drive big loads.
8) Understand Combinational MOS logic circuits.
9) Design, implement and test: Random Number Generator (deleted, subsumed by #17)
10) Understand Sequential MOS logic circuits.
11) Understand Dynamic logic circuits.
12) Understand the working of ROM and RAM.
13) BiCMOS deleted, touched somewhat (2^{nd} edition of text deletes it also)
14) Understand limitations of the technology: Short channel effects.
15) Understand the use of chip I/O circuits.
16) Understand the design for manufacturability and testability.
17) Design, implement and test: Sequential circuits
18) Understand the fundamental concepts and technology implications of very short channel devices
19) Discover how to figure out key aspects of a completely unknown topic in circuits and systems (homework #1)

Course Outcomes mapped to Program Outcomes:

Program Outcomes:	a	b	c	d	e	f	g	h	i	j	k
Course Outcomes:	All	4 7 9 17	16	4 7 9 17	5 6 8 10 11 12 13 14	15 16	4 7 9 17	14 16 18	14 16 18 19	13 14 15 16 18	4 7 9 17
Emphasis:	5	5	1	1	5	2	2	3	3	3	5

Contribution of Course to Meeting the Professional Component:
Engineering topics: 90%
Math & Basic Science: 5%
General Education: 5%

Prepared by: Allyn E Hubbard **Date:** January 12, 2009