The Hong Kong University of Science & Technology
Department of Electronic & Computer Engineering

ELEC4410: CMOS VLSI Design [3 Credits]

Course Description
CMOS process and design rules; MOS device electronics; CMOS circuit and logic circuit characterization and performance estimation; VLSI design and verification tools. Laboratory work will be centered on industry standard tools.

Prerequisites
ELEC 2200 or ELEC 3310 or ISDN 4000D

List of Topics

Lecture Outline
Week 1 Course Description, VLSI Overview
Week 2 CMOS Device Theory, Modes of Operation, Device Model
Week 3 Device Characteristics and Equations
Week 4 CMOS Technology and Fabrication, MOS Physical Parameters
Week 5 Fabrication Imperfections and Layout
Week 6 Design Rules, Stick Diagrams
Week 7 CMOS Combinational Logic Circuit Design
Week 8 CMOS Layout and Packaging
Week 9 CMOS Inverter DC Characteristics
Week 10 Noise Margin, Fan-in and Fan-out
Week 11 Timing and Dynamic Behavior of CMOS Inverter
Week 12 Timing Analysis for CMOS circuits, Signal Delay, Driving Large Capacitance
Week 13 Advanced Design Consideration and Other Design Styles

Laboratory Outline:
Lab 1 UNIX Setup and Cadence Basics, Schematic Entry
Lab 2 Simulation with the Analog Design Environment
Lab 3 Hierarchical Schematic Design
Lab 4 Cadence Layout Tutorial
Lab 5 Layout Versus Schematic (LVS)
Lab 6 Post-Layout Simulation and Hierarchical Layout

Statement of Objectives/Outcomes:
On successful completion of this course, students will be able to:
CO1 – recognize the advantages and critical importance of CMOS technology for very-large-scale integration
CO2 – understand the physical structure and operation of digital CMOS integrated circuits
CO3 – use a computer-aided-design tool for developing and characterizing CMOS integrated circuits
CO4 – design and demonstrate high-performance and compact digital CMOS integrated circuits
CO5 – understand the basic principles and current challenges in CMOS technology scaling
CO6 – foresee the evolution of the integrated circuits technology for the next 10+ years
CO7 – manage small-scale group projects
CO8 – demonstrate effective communication skills
CO9 – understand the professional and ethical responsibilities of engineers.

Textbook
Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, Digital Integrated Circuits – A Design Perspective, Second Edition, Prentice Hall, 2003.

Reference Books

John P. Uyemura, Chip Design for Submicron VLSI: CMOS Layout and Simulation, Thomson, 2006.
Erik Brunvand, Digital VLSI Chip Design with Cadence and Synopsys CAD Tools, Addison-Wesley, 2010.

Grading Guideline

Laboratory – 15%
Midterm – 20%
Final – 40%
Project – 25%