CMPEN 411  
VLSI Digital Circuits  
Elective Course in Computer Engineering

Catalog Data:  
VLSI Digital Circuits (3)  
Digital integrated circuit design, layout, simulation, and fabrication; VLSI design techniques and system architecture; computer-aided design tools and techniques.  
Prerequisite: CMPEN 371 or CMPEN 471, EE 310.

Typical Textbook:  

Course Objectives:  
This course is designed to give seniors in computer engineering, electrical engineering, and computer science insight into the design of modern VLSI chips, especially CMOS approaches to design.

Primary Course Outcomes:  
- Design the electronic/logic circuits that form the basic building blocks of a computer system.
- Design, implement, verify and evaluate the operation of a digital systems.

Relationship to Undergraduate Program Outcomes:  
This course collectively supports the following program outcomes:
- Design of the electronic/logic circuits that form the basic building blocks of a computer system.
- Analyze the performance of hardware systems using simulation methods.
- Demonstrate independent learning by using unfamiliar computer systems and software tools to solve technical problems.
- The ability to discuss major trends in industry and current research activities within computer architecture design.
- Apply the principles of electricity, magnetism and modern physics to the design and analysis of circuit, system, and devices.
- Write clear and effective technical prose for a technical audience.

Required Topics:  
Introduction to VLSI design (~4 hrs).  
Fabrication and Layout of VLSI Circuits: MOS transistor fundamentals, CMOS processing steps, design rules, and electrical parameters (~3 hrs).  
Combinational Logic Circuit Design: Static CMOS logic, pass transistor logic, Dynamic CMOS (~4 hrs).  
Sequential CMOS Circuits: Storage elements, clocking, registers, and sequential systems design (~7 hrs).  
Delay and Power (~4 hrs).  
Subsystems Design: Shifters, adders, multipliers, ALUs, ROM, RAM, and PLAs (~6 hrs).  
VLSI Architecture Design: Register-transfer level, data path/control specification, high level synthesis, and testing (~3 hrs).  
Exams and Review (~3 hrs).

Class Format:  
Lecture: 75 minutes, 2 lectures a week, 15 week/semester  
Laboratory: Open Lab. 24hr. access, first-come-first-served, appointment for demonstration.

Professional Component:  
This course provides a design emphasis in the area of digital, computer, and electronic circuits. It is designed for the senior-level system designing. Topics pertaining to economics and time-to-market analysis are considered in the context of electronic and computer product development.
Evaluation: ~50% proctored assessments (exams)  
~50% unproctored assignments (homeworks, programming projects)

Suggested breakdown based of 100 pts as follows:
15      Exam 1
15      Exam 2
20      Final
15      Course Project
35      Assignments (Lab projects and homeworks)

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Last Revised: January 18, 2008