CSET 4200: VLSI Technology (4 semester credit hours) CSET Elective

Current Catalog Descriptions:

Introduction to CMOS technology and circuits, MOS transistor switches and CMOS logic. Practical aspects of silicon manufacturing technology including wafer processing, layout design rules and process parameterization. Electrical and physical design of logic gates, clocking schemes, I/O structures and structure design strategies.

Textbooks/Software

1. "CMOS VLSI Design," Neil Weste and David Harris, Addison Wesley Publishers
2. Mentor Graphics Software

Related Program Outcomes:

CSET Program Objectives (b, c, d, f, h and i) – see table

Course Objectives

In this course, students are expected to satisfy the following objectives:

- In-depth knowledge of VLSI circuits and their practical applications in implementing combinational and sequential digital circuits. Students will be required to design VLSI chips in the laboratory. Successful designs will be submitted to MOSIS for fabrication.
- The ability to design VLSI layouts using Mentor Graphics tools.
- Practical knowledge of VHDL language and the ability to write VHDL programs for implementing VLSI digital circuits.
- The ability to prepare and submit well-written reports and software programs for assigned lab exercises.
- The ability to do team projects in VLSI and submit written reports and give oral presentations. Innovative projects will be encouraged.
- The ability to keep abreast of the latest technology by reading appropriate journal/conference papers and other scientific magazines in the area of VLSI. Students will be required to cite their readings in their project reports.

Major Topics Covered in the Course

Topic	Lecture Hours
Introduction to VLSI	4
MOS Transistor Theory	3
CMOS Processing Technology	4
Circuit Characteristics and Performance Estimation	5
Circuit Simulation	4
VLSI Combinational Circuit Design	4
VLSI Sequential Circuit Design	4
Design Methodology and Tools	5
Testing and Verification of VLSI Circuits	4
Data-path Subsystems	4
Total:	41

Laboratory projects

Students are assigned approximately 8 individual lab assignments. Each of these assignments require approximately 1 to 2 weeks for completion. Students are also assigned a class term project (team of 2 or 3 students). Term project requires a formal written report and an oral presentation.

Major Laboratory Topics

- Mentor Graphics: Getting Started
- Schematic Entry.
- Switch Level Simulation.
- Layout.
- Layout Verification.
- Hierarchical Design Rules.
- Gate Design: NAND.
- Gate Design: NOR/OR.
- Design of Full Adder.

Oral and Written Communications

Every student is required to submit at least 5 written reports (not including exams, tests, quizzes, or commented programs) of typically 4 to 8 pages and to make 1 oral presentation of typically 15 to 20 minutes duration. Students work in teams for the term project. The project consists of a written report as and oral presentation.

Distance Learning students must:

- submit a video-taped oral presentation for evaluation and feedback, or
- come to UT or a partner community college and make the oral presentation in person, or
- submit completed evaluation forms for the oral presentation from an approved proctor or audience group.

Social and Ethical Issues

Social and ethical issues are emphasized in regards to copyright and proper acknowledgement in writing the term project report. Students are required to cite at least 5 references from published literature as a part of literature survey on the topic selected for the project. Students also grade the oral presentation of each fellow student. The grades are subject to 'moderation' by the Instructor, if deemed necessary. Students show fairness and honesty in grading their classmates. Other social and ethical issues are discussed as deemed necessary. Approximately ½ hour is spent on instructing the students on the importance of fairness and honesty in grading their fellow students.

Theoretical Content

- Introduction to VLSI. (1 week)
- MOS Transistor Theory. (2 weeks)
- CMOS Processing Technology. (2 weeks)
- Circuit Characteristics and Performance Estimation. (1week)
- Circuit Simulation. (2 weeks)
- Combinational Circuit Design. (1 week)
- Sequential Circuit Design. (1 week)
- Design Methodology and Tools. (2 weeks)
- Testing and Verification. (2 weeks)
- Data-path Subsystems. (1 week)

Problem Analysis

Students analyze VLSI circuits to estimate circuit characteristics and performance.

Solution Design

Students design VLSI circuits using Mentor Graphics. The circuit is modeled using LSIM. Students verify their theoretical design experiences by simulating the functional behavior of the circuit.

Course Coordinator

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Modified by Dan Solarek (daniel.solarek@utoledo.edu), 6-22-2011

	Student Outcomes: **CSET Program**	Course Outcomes	Assessment Methods
a	an ability to select and apply knowledge of computing and mathematics appropriate to the discipline. Specifically, an ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices. [CAC-j]		
b	an ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.	Practical knowledge of VHDL language and the ability to write VHDL programs for implementing VLSI digital circuits.	Design and analysis using Mentor Graphics and VHDL hardware description language
c	an ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs. Specifically, an ability to apply design and development principles in the construction of software systems of varying complexity. [CAC-k]	The ability to design VLSI layouts using Mentor Graphics tools.	Design and analysis using Mentor Graphics and VHDL hardware description language
d	an ability to function effectively as a member or leader on technical teams to accomplish a common goal.	The ability to do team projects in VLSI and submit written reports and give oral presentations.	Working with other students in a team of 3 to 4 students on a project.
e	an understanding of professional, ethical, legal, security and social issues and responsibilities including a respect for diversity.		
f	an ability to communicate effectively with a range of audiences using a range of modalities including written, oral and graphical.	The ability to prepare and submit well-written reports and software programs for assigned lab exercises and give oral presentations.	Oral presentation of project work. Written reports of projects.
g	an ability to analyze the local and global impact of computing on individuals, organizations, and society.		
h	recognition and understanding of the need for and an ability to engage in self-directed continuing professional development.	The ability to keep abreast of the latest technology by reading appropriate journal/conference papers and other scientific magazines in the area of VLSI.	To review, digest, and apply the latest design techniques in the area of VLSI design and fabrication by referencing various conference and journal papers.
i	an ability to select and apply current techniques, skills, and tools necessary for computing practice.	In-depth knowledge of VLSI circuits and their practical applications in implementing combinational and sequential digital circuits.	Design and analysis using Mentor Graphics and VHDL hardware description language
j	an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.		
k	a commitment to quality, timeliness, and continuous improvement.		