ELEG 404: Digital VLSI

Semester: Spring 2012.
Class Time: Mon. Wed. 3:00pm-4:15pm.
Classroom: Dana Hall of Science, Room 236.
Instructor: Xingguo Xiong (Associate Professor)
Office: Tech 140.
Office Hours: Tue. Thur. 3:00pm-4:00pm, Wed. 4:30pm-5:30pm.
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Description: Digital VLSI (Very Large Integrated Circuits) has enabled computer-based Information Technology and brought revolutionary change to human society. Nowadays, the feature size of modern VLSI has been scaled down to nanometers. A state-of-the-art Intel CPU may integrate multi-cores and contain billions of transistors. The rapid technology advancement imposes new challenges to modern VLSI design engineers. This course introduces the design methodologies and analysis of digital VLSI systematically, such as combinational and sequential circuit design, memory and arithmetic units. It also covers the design optimization in area, performance, power and testability.

Credit: 3

Textbook: Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, *Digital Integrated Circuits: A Design Perspective*, Prentice Hall, 2nd edition, Dec. 24, 2002, ISBN-10: 0130909963, ISBN-13: 978-0130909961.

Reference: David Harris, Neil H.E. Weste, *CMOS VLSI Design: A Circuits and Systems Perspective*, Addison-Wesley, 3rd edition, May 11, 2004, ISBN: 0321-14901-7, ISBN 13: 978-0321-14901-5

Wayne Wolf, *Modern VLSI Design – System-on-Chip Design*, Prentice Hall, 3rd Edition, Jan. 14, 2002, ISBN: 0130-61970-1, ISBN 13: 978-0130-61970-9.

Peter J. Ashenden, *The Designer's Guide to VHDL*, Morgan Kaufmann Pub., 2nd edition, Jun. 05, 2001, ISBN: 1558-60674-2, ISBN 13: 978-1558-60674-6

Neil H. E. Weste, Kamran Eshraghian, Michael John and Sebastian Smith, *Principles of CMOS VLSI Design: a Systems Perspective*, Addison Wesley, Nov. 30, 2004, ISBN: 0321-22337-3, ISBN 13: 978-0321-22337-1.

Yusuf Leblebici, Sung-Mo Kang, *CMOS Digital Integrated Circuits: Analysis and Design*, McGraw-Hill College, 3rd edition, Oct. 29, 2002, ISBN: 0072-46053-9, ISBN 13: 978-0072-46053-7.

John F. Wakerly, *Digital Design: Principles and Practices*, 4th edition, July 27, 2005, Prentice Hall, ISBN: 0131733494.

Goals: Upon completing this course, students will have a comprehensive understanding about digital VLSI design. Students will gain hands-on design experience through the usage of state-of-art EDA tools, including PSPICE, Mentor Graphics tools and Synopsys tools. The goal of this course is to prepare students as digital VLSI design engineers to meet the increased demand of modern VLSI industry.

Prerequisites: Fundamentals in microelectronics or digital circuit design.

Topics:
1. Digital VLSI design: Boolean logic, Karnaugh map.
2. MOS transistors, CMOS logic family.
3. CMOS layout and fabrication process.
4. CMOS inverter analysis.
5. Designing combinational logic gates in CMOS.
6. Designing sequential logic circuits.
7. Design for performance: delay models, critical path analysis
8. Designing arithmetic building blocks.
9. VHDL design, logic synthesis, timing analysis/optimization.
10. Coping with Interconnect.
11. Timing issues in digital circuits, clock distribution.
11. Designing memory and array structures.
12. System design: floorplaning, partition and placement.
14. Design for low power.
15. Design for Testability.

Grading: The final grade will be 15% on homework, 15% on projects, 31% on mid-term exam, 35% on final exam, and 4% on attendance. There are four times of random attendance during the whole semester. Each attendance will be counted 1 point toward your final grade.

Exams: There will be two exams: the mid-term exam and the final exam.

Computer Usage: VLSI EDA tools (Cadence OrCAD PSPICE, Mentor Graphics tools, ModelSim, Synopsys tools, etc.) on Windows and Linux platforms.

Lab Projects: There will be several digital VLSI circuit design projects. These include layout design of digital circuits, design and simulation of combinational and sequential circuits in PSPICE, VHDL design and logic synthesis of digital VLSI circuits, etc. Through these projects, students will learn various design strategies for modern digital VLSI.

Cheating Policy: It is the student's responsibility to familiarize himself or herself with and adhere to the standards set forth in the policies on cheating and plagiarism as defined in Chapters 2 and 5 of the Key to UB (http://www.bridgeport.edu/pages/2623.asp) or the appropriate graduate program handbook.