ECE4130 Course Syllabus

ECE4130

Advanced VLSI Systems (3-0-3-4)

CMPE Degree

This course is Elective for the CMPE degree.

EE Degree

This course is Elective for the EE degree.

Lab Hours

3 supervised lab hours and 0 unsupervised lab hours

Course Coordinator

Raychowdhury,Arijit

Prerequisites

ECE 3050 or ECE 3060 or ECE 3150 or ECE 3400

Corequisites

None

Catalog Description

An advanced treatment of VLSI systems analysis, design, and testing with emphasis on complex systems and how they are incorporated into a silicon environment. Credit is not allowed for both ECE 4130 and ECE 6130.

Textbook(s)

Uyemura, *Introduction to VLSI Circuits and Systems* (1st edition), John Wiley, 2002. ISBN 0471127043, ISBN 9780471127048 (required)

Course Outcomes

Upon successful completion of this course, students should be able to:

1. Explain the working principles for MOSFETs and CMOS logic.
2. Provide detailed analysis and explanation of power and performance of digital CMOS logic gates.
3. Provide detailed design, analysis and explanations of both combinational as well as sequential circuit design including static random access memory circuits.
4. Explain clocking, power management and clock/power distribution circuits.
5. Design, simulate and analyze both schematics and layout of digital circuits using the state-of-the-art computer-aided-design tools.

Student Outcomes

In the parentheses for each Student Outcome:
"P" for primary indicates the outcome is a major focus of the entire course.
“M” for moderate indicates the outcome is the focus of at least one component of the course, but not majority of course material.
“LN” for “little to none” indicates that the course does not contribute significantly to this

outcome.

1. (M) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. (LN) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. (LN) An ability to communicate effectively with a range of audiences
4. (LN) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. (M) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. (P) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. (LN) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topical Outline

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Current State of VLSI
       Fabrication and Size Metrics
      Performance Metrics
      System Complexity

 Complex VLSI Systems
      Architectural Trends in Microprocessors
      The Large VLSI Chip
           Modules, Units, and VHDL
           Floorplanning, Interconnect, Clock Distribution
           System Hierarchies: VHDL to Silicon
      Timing Issues

 High-Performance CMOS Design Styles
      Transient Analysis and Sizing
      Dynamic Logic Networks
      Domino, Advanced Dynamic, SR and ST Logic
      Dual-rail Differential Logic Families
      Advanced Design Techniques
      Clock Distribution Techniques
      High-speed I/O Networks
      Examination of Current Literature
           Standard-cell to Full-custom
           Critical Metrics and Physical Limitations
      Packaging Issues

 The VLSI Design Environment
      System Specifications
      Efficient Usage of Design Libraries and Hierarchies
      Toolsets at the User Level
           LVS, Logic Simulation, Circuit Simulation, Place & Route
      Design of Toolsets
           Review of Basic Algorithms
           Database Structure and Usage
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Design Automation and VLSI

Layout, Placement, Routing, Silicon Compilation

Synthesis Tools