ECE 5/629 CAD for ULSI and Emerging Technologies

Catalog Description

Course will cover Computer-Aided Design (CAD) challenges for ultra submicron CMOS system design and circuit and system design in new emerging technologies. It will cover (1) system design approaches and optimization techniques in the presence of process and environmental parameter variations (2) statistical approaches to circuit and system design, (3) physical design (layout) role in performance evaluation of digital systems, and (4) design and architecture outlook for beyond CMOS Switches. Prerequisites: ECE 428/528 or consent of instructor.

Credit hours 4

May be taken only once for credit.

Goals

Students will attain solid understanding of major challenges and optimization approaches in physical design of integrated systems that are fabricated in most current technologies. Students will be able to do independent study of new problems arising with new technologies and nano-materials and devices. Students will learn how to analyze research papers and how to questions presented solutions and results.

Course Coordinator

Prof. Malgorzata Chrzanowska-Jeske

Textbooks

No textbook

We will read and study research papers relevant to topics that will be discussed. Usually students will start investing a topic by reading survey and/or tutorial type papers. Papers will be posted on class D2L.

Prerequisites

ECE 428/528 or consent of instructor.

Students are expected to be familiar with the usual freshman engineering background in Physics, Chemistry and Math, sophomore circuits and junior electronics and senior digital circuit design classes. ECE 581 ASIC Modeling and Synthesis, ECE 583 Low Power IC Design and ECE 516 IC technology useful but not expected.

Course Learning Outcomes

At the end of this course, students will have:

1. An understanding of current challenges in physical design of complex ICs.
2. An understanding of all stages of physical design and most typical optimization techniques.
3. Ability to formulate problems in physical design of complex systems.
4. An understanding of performance and power evaluation on various stages of physical design.
5. An understanding of designing and optimization of signal, clock and power/ground networks.
6. An understanding of system design optimization in the presence of variations
7. An understanding of statistical approach to complex system design
8. Ability to understand trade-offs between various design objectives
9. An understanding of early design evaluation of the role of floorplanning.
10. Ability to write concise, accurate and complete technical reports.

Topical Outline

Changes slightly every year and depends on the most recent advances in VLSI technology

- Interconnects and timing analysis
- Process and environmental variability
- Power and hot spots
- Clock and P/G designs
- Reliability and Yield
- Early design exploration with floorplanning
- Emerging architectures – vertical integration
    - 3D ICs with Through-Silicon-Vias (TSVs)
    - Monolithic 3D ICs
- Emerging materials for devices, interconnects and heat dissipation
    - CNTs
    - Graphene

Course Structure

Two 100-minute lecture periods per week.

Relevant Student Outcomes

The following student outcomes are supported by this course:

(a) Ability to apply mathematics, science and engineering principles;

(b) Ability to design and conduct experiments, analyze and interpret data

(c) Ability to design a system, component, or process to meet desired needs.

(d) Ability to identify, formulate and solve engineering problems.

(f) Ability to communicate effectively.

(h) Recognition of the need for and an ability to engage in life-long learning

(i) Knowledge of contemporary issues.

(k) Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

Prepared by: Malgorzata Chrzanowska-Jeske

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Winter 2019 Course Announcements: