



Course Announcement

The Department of Electrical and Computer Engineering Santa Clara University

ELEN 601: Low Power Design of VLSI Circuits and Systems

Dr. Vivek Tiwari

Vice President, Intel Product Assurance and Security, Intel Corporation

Spring 2023; Class Time (T/Th 7:10pm - 9:00pm)

Power consumption is a critical aspect of modern electronic systems as it directly affects their performance, usability, reliability, cost and even their environmental impact. In the last three decades, power consumption has gone from being a second order effect that was relevant only to power delivery designers, to being the fundamental limiter of Moore's Law! As VLSI technologies pervade every aspect of modern life, power consumption has become the fundamental design attribute for computing systems and something that affects every aspect of the VLSI electronics and computing industry. This course will cover the fundamental concepts of power consumption in VLSI and system design, including power analysis and estimation, power optimization, and power management, introducing various power-saving techniques, such as clock gating, power gating, dynamic voltage and frequency scaling, logic and circuit optimizations, power-aware architectures, system-level power management and more.

The course will be series of lectures, including guest lectures on different aspects of power consumption and power efficient design. It will be a unique opportunity to learn directly from leading experts in academia and industry who will provide real-world insights into the challenges and best practices in power efficient design. The course is designed to encourage students to develop curiosity and insights about power related topics through an emphasis on class participation and independent exploration.

Course outline:

- Milliwatts to Megawatts – power challenges in the Smart Connect World (overview lecture)
- Basics of power consumption in CMOS circuits and key power optimization concepts
- Energy efficient logic design (and logic design tools)
- Unified Power Format (UPF) overview – expressing power intent through HW design languages
- Architecture-level power analysis and optimization techniques
- Power delivery for integrated circuits
- Future directions – brain-inspired computing and power-efficient machine learning
- Independent project based on exploration and synthesis of literature (students are encouraged to pick topics closest to their own areas of interest)

Prerequisite skills / knowledge:

- Students should have basics of VLSI Design concepts (circuits/systems) to be prepared, e.g. ELEN 387 or ELEN 115 & 127, ELEN 153 or equivalent
- Basics of computer architecture (optional)