**University of California, Santa Barbara**
Department of Electrical and Computer Engineering

# ECE 194/594: Introduction to Nanoelectronics
# Spring 2013
(Tue & Thu, 4:00pm-5:50pm, ENGR 2, 3301)

**Instructor:**
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**Prerequisites:**

- College Level Physics, Chemistry, and Math

- Some knowledge of the following areas is desirable:
  i) Materials Science
  ii) Quantum Mechanics
  iii) Solid-State Physics
  iv) Electronic Devices and Integrated Circuit Design (ECE 124A level)

**Recommended Text:**

- *Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications,* V. Mitin, V. Kochelap and M. Stroscio, Cambridge Univ. Press, 2008.

**Other References:**

- *Quantum Transport: Atom to Transistor*, S. Datta, Cambridge Univ. Press, 2005.
- *Emerging Nanoelectronics: Life With and After CMOS*, Eds. A. M. Ionescu and K. Banerjee, Springer-Verlag, 2004.
- *Selected Publications,* to be posted on course website.

**Grading:**

- Assignments: 50%
- Project: 50%
  - 10% - Introduction to the problem: background material
  - 30% - Literature survey: what is the state-of-the-art?
  - 30% - Identifying the research problems: what is important & why?
  - 30% - Proposed solution and analysis: what is novel?

***Note:*** Need to submit soft-copies of the project presentation slides (source file) by end of quarter.

**SUGGESTED FOCUSED AREAS FOR PROJECT:**

1. Electrical Transport in Nanostructures
    i. Various transport models and simulation methods
    ii. Applications to novel devices
2. Thermal Transport in Nanostructures
    i. Modeling of thermal transport at the nanoscale
    ii. Implications for emerging nanoelectronics
3. Emerging Nanomaterials and Structures
    i. 1D structures: Carbon nanotubes and nanowires
    ii. 2D structures: Graphene and beyond-graphene materials
    iii. Novel heterostructures enabled by low-dimensional structures
4. Applications of Nanomaterials and Nanostructures
    i. Electronics (solid-state): transistors, interconnects, passive devices, logic and memory elements
    ii. Nano-electromechanical systems: transistors, resonators, RF switch
    iii. Energy storage and conversion: photovoltaics, thermoelectrics, hydrogen storage, battery, etc
    iv. Bio/Gas sensors, flexible electronics
5. Reliability and Variability in Emerging Nanoelectronics