GEORGE MASON UNIVERSITY
ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT

Spring 2014        ECE 685: Nanoelectronics
Time and location: Tuesday 4:30 pm – 7:10 pm, Robinson Hall A123
Instructor: Qiliang Li, Engineering Bldg, Room 3250, Tel 703-993-1596, Email: qli6@gmu.edu
Office Hours: Friday 1:20 – 3:20 pm; other times by appointment.

COURSE DESCRIPTION
This course focuses on the fundamental concepts and principles of nanoelectronic materials and devices. Nanoelectronics is concerned with electronic devices with one or more dimensions at nanoscale. The lecture will cover the electronic properties of solids including semiconductors in samples of physical dimension of ~100 nm or less, and the corresponding basic device building blocks such as quantum dot (QD), single electron transistor (SET), nanowire, carbon nanotube (CNT), graphene, etc. The course will consider the design and analysis of a variety of nanoscale devices (“quantum” or “mesoscopic” devices) and examine the most notable, novel applications.

PREREQUISITES: ECE 584 – Semiconductor Device Fundamentals or equivalent courses

RECOMMENDED READINGS:
2. “Nanoelectronics and Information Technology”, 2nd Ed. by Rainer Waser (Ed.)

COURSE OUTLINE
1. Course and Syllabus Overview
2. Classical particles, classical waves, and quantum particles
3. Quantum Mechanics of Electrons
4. Confined Electrons / Electrons Subject to a Periodic Potential
5. Tunnel Junctions and Applications of Tunneling
7. Carbon Nanotubes and Nanowire Transistors
8. Many Electron Phenomena-Particle Statistics
9. Models of Quantum Wells, Quantum Wires and Quantum Dots
10. Nanowires, Ballistic Transport, and Spin Transport
11. NanoCMOS / Silicon-on-Insulator (SOI) CMOS
12. Fundamental Limits to Scaling

GRADING
Homework + project-1 + project-2 20% + 15% + 15%
Midterm Exam 25%
Final Exam 25%
(Exam will be announced in class at least two weeks before the exam.)