EE 396V – Semiconductor nanostructures

Spring 2009

Description:

Advances in technology and fabrication of semiconductor structures have led to devices with size smaller that the electron mean free path. In this regime the structure and geometry intimately determine the device electronic properties. This course covers the theoretical framework for understanding the electronic properties, a review of state of the art fabrication techniques and reviews recent experimental results of quantum confined devices, such as semiconductor heterostructures, quantum wires and quantum dots.

Instructor: Prof. Emanuel Tutuc, 1.606 MER, ENS 520A, E-mail: etutuc@mail.utexas.edu.

Class hours: MW 9:30-11:00am; Office hours: ENS 520A, W 11am-12pm; 1-3pm.

Objectives:

- Review a number of key nanoscale, quantum confined electronic devices.
- Understand the electronic properties of these nanostructures devices.
- Explore possible applications of semiconductor nanostructure devices.

Prerequisites:

Quantum mechanics and solid state physics (undergraduate level) are strongly recommended.

Tentative course topics:

- Brief review of quantum mechanics and solid state physics
- Two dimensional systems: band engineering, doping modulation.
- Semiconductor growth techniques: molecular beam epitaxy, chemical vapor deposition.
- Less than two dimensional systems: mesoscopic systems.
- One dimensional transport, quantum point contact, conductance quantization.
- Quantum dots, single electron transistor, Coulomb blockade.
- Semiconductor nanowires, carbon nanotubes.
- Spin injection, spin based devices.

Recommended references:

- *The physics of low-dimensional semiconductors,* by John H. Davies
- *Quantum transport: Atom to transistor,* by S. Datta
- *Transport in nanostructures,* by D. K. Ferry and S. M. Goodnick

Grading:

40% Homework, 30% Midterm, 30% Final.
Late homework will be accepted at instructor's discretion.
Discussion of homework questions is encouraged. Please be sure to submit your own independent homework solution.

Course notes:

Course notes will be provided for most lectures. Occasionally, journal publication of relevance to the lecture topics will accompany the course note. The web-based course management system "Blackboard" will be used.

College Drop/Add Policy:

An engineering student must have Dean's approval to add/drop after the fourth class day of the semester.

Academic dishonesty:

Plagiarism or any form of academic dishonesty (cheating includes, but is not limited to, copying another student's work, bringing notes into a test and copying material directly from a book, article or web site without including appropriate references, falsifying data, doing someone's work) is a violation of University rules and may return a grade of zero for each assignment in which it is detected or may incur even steeper penalties. For University policies see: http://www.utexas.edu/opa/news/04newsreleases/nr_200404/nr_honor040429.html

Class Web sites and student privacy:

Web-based, password-protected class sites are associated with all academic courses taught at The University. Syllabi, handouts, assignments and other resources are types of information that may be available within these sites. Site activities could include exchanging e-mail, engaging in class discussions and chats, and exchanging files. In addition electronic class rosters will be a component of the sites. Students do not want their names included in these electronic class rosters must restrict their directory information in the Office of the Registrar, Main Building, Room 1.

Students with Disabilities:

The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641 TTY or the College of Engineering Director of Students with Disabilities at 471-4382.