Fundamental Principles of Nanoelectronic Devices – Spring 2007 - ELEG 446/ 646

SYLLABUS

Instructor: Dr. James Kolodzey

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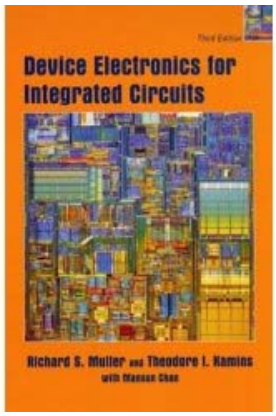
Office Hours: Tues/Thurs 3:30 p.m. - 4:30 p.m. Eastern Time.

First Meeting: Tuesday, 6 February 2007, in 109 Colburn Lab, 5:30 pm

Meetings: Tu & Th 5:30 to 6:45 pm Eastern Time; Location: 109 Colburn Lab (COL)

Course website: http://www.ece.udel.edu/~kolodzey/courses/eleg646s07.html

Prerequisites: Undergraduate courses in materials and devices. (such as ELEG 340)



Text: Richard S. Muller, Theodore I. Kamins and Mansun Chan, "Device Electronics for Integrated Circuits," 3rd Ed., J. Wiley & Sons, 2003, ISBN 0-471-59398-2

Objectives:

1) Introduce the principles that govern the operation and design of important electronic and optical devices, and that motivate novel concepts.

2) Describe the characteristics and limitations of devices that are based on junctions and barriers between different materials and structures.

3) Explain the operation of important devices including diodes and transistors.

Description:

Introduce the fundamental principles of semiconductor devices; derive the operating characteristics of several important device examples; understand the characteristics and limitations of important devices; learn their design and usage; conceive novel devices.

Course Topics:

- Metals, semiconductors, insulators, and organics (polymers and biomaterials)
- Drift, diffusion, recombination, tunneling

- Carriers, distribution functions, density of states
- Equilibrium and nonequilibrium properties: carrier injection, optical generation, lifetimes
- Junctions: bias, Fermi potentials, capacitance, I-V characteristics
- Transistors: bipolar and field effect characteristics, gain, limitations, and scaling
- Microwave devices: IMPATT, Gunn, mixers and detectors
- Tunnel devices: tunnel diodes, resonant tunneling
- Optoelectronic devices: photodetectors, LEDs, and lasers
- Mesoscopic devices: behavior in the nanoscale: quantum wells, wires and dots; molecular electronics, spintronics

Policies:

Attendance: Students are expected to attend every class; and are responsible for the material covered in the lectures and the reading assignments.

Grading: Homework will account for 35% of your grade, the short quizzes for 25%, the final exam for 35%, and the project for 5%.

Homework: Problem sets assigned weekly, and due the following week. Homework assignments will be posted on the course website (http://www.ece.udel.edu/~kolodzey/courses/eleg646s06.html). Homework will be graded on a "logical approach" basis rather than on whether you obtain the right answer. Thus you should be able to obtain 100% on the homework by making a reasonable effort to solve all problems and submitting them. Please include the University course number, date and assignment number on your homework submissions.

Exams: Biweekly short quizzes and a Final exam. Each quiz will cover roughly the preceding few lectures of course material, but the final will be comprehensive. The quizzes will be 15 minutes long; the Final will be 2 hours long. Be sure that you understand the homework problems before taking exams. Please feel free to see me to ask any questions.

Course Project: Device Design Project. Design your concept of a device and describe its operation in terms of the topics in the course lectures. Report Format: 1 page description, and 1 page analysis. Due May 8. (2 pages maximum - please use only your own calculations and your own drawn figures - web figures will be automatically rejected and require resubmission - no exceptions)

last updated: 25 January 2007