Instructor: Dr. James Kolodzey
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Office Hours: Tues/Thurs; 11 am – 11:30 am, and 3:30 p.m. - 4:30 p.m. Eastern Time.

First Meeting: Tuesday, 9 February 2010, in 114 Gore Hall
Meetings: Tu & Th; 9:30 to 10:45 am Eastern Time; 114 Gore Hall
Course website: http://www.ece.udel.edu/~kolodzey/courses/eleg646s10.html

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


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.

**Class Seminars:** Each student will have a chance to lead a review session on the topics covered in the previous lecture. The review session will last about 20 minutes. It is expected that these sessions will help you assimilate the course material.

**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/eleg646s10.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:** Several short quizzes (roughly biweekly) 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 about 25 minutes long; the Final will be about 2 hours long. Be sure that you understand the homework problems, and study the lecture notes and read the text to prepare for the quizzes. Please feel free to see me with 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. There will be two reports. The first will be roughly mid semester (after the break) and will be a brief oral description (about 2 minutes per person) about the device that you intend (at least at that moment) to report. The second, written report will include: 1 page description, and 1 page analysis. Due May 11. (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: 20 January 2010