

3.15: Electrical, Optical and Magnetic Materials and Devices

Fall 2003 C.A. Ross

ABET Educational Objectives and Outcomes

I. Instructional objectives and outcomes

1. Analyse the behavior of carriers (electrons and holes) in semiconductors in terms of drift, diffusion and recombination/generation.
2. Understand the meaning of energy levels in semiconductors, including the position of the fermi level at equilibrium and out of equilibrium.
3. Describe the operation of a pn junction and apply this understanding to more complex situations (bipolar junction transistor, junction field effect transistor, solar cell, light emitting diode, laser diode, etc.)
4. Understand the behavior of light in solids and how this can be incorporated into photonic devices, waveguides, optical fibers etc.
5. Understand basic magnetic quantities (field, induction, moment) and phenomena (e.g. induction) and apply to simple devices (d.c. motor, disk drive, transformer).
6. Demonstrate ability to select materials for device applications based on the desired optical, electrical or magnetic performance of the device.
7. Demonstrate ability to research the literature and to summarize important findings in writing.

II. Strategies

1. *Lectures*: 3 hours per week, and *Recitation*, 1 hour per week. Encouragement of classroom participation and discussion.
2. *Homework assignments*. Reading assignments to supplement lectures. Seven problem sets, at 1-2 week intervals, to practice application of concepts learned in lectures.
3. *Term paper*. Each student researches a particular device to determine how the desired device performance governs the choice of material and processing route. 8-10 page written report.
4. *Exams*, two during class time and one final exam, all closed book, to test understanding of concepts (rather than testing numerical problem solving)

III. Assessment methods

1. *Portfolio analysis*. Graded problem sets form a record from which a quantitative assessment of mastery of concepts can be made. These constitute 10% of final grade
2. *Examinations*. Two during class time, approximately 1/3 and 2/3 of the way through the lecture schedule, to test mastery of the first and second third of the material (15% of grade each). Final exam (30% of grade) tests synthesis of concepts.
3. *Term paper* (30% of final grade) assesses ability to research and summarize the literature and to apply materials selection criteria to electronic/optical/magnetic devices.
4. *Self assessment*. Students will complete an evaluation to assess how well the objectives and outcomes were satisfied.
5. *Instructor assessment*. Instructor will prepare memorandum that summarizes the success of the subject and outlines suggestions for improvement.