Purdue University Fall 2013

EE 656: Electronic Transport in Semiconductors

Outcomes

This course is about how charge flows in semiconductors with an emphasis on carrier transport in bulk semiconductors and in micro- and nano-scale devices. The objective is to help you develop a broad understanding of the fundamentals of carrier transport. You will not learn everything you'll need to know for the rest of your career, but you will have a foundation, a starting point, from which you can teach yourself what you need to learn in your research and engineering work. The course is designed for those who work on electronic materials and devices – whether they are experimentalists, device physicists, or computational experts.

Specific Outcomes:

A student who successfully completes this course will:

1) Understand advanced semiconductor fundamentals such as bandstructure, density-of-states, quantum confinement, and carrier scattering.

2) Understand the Landauer Approach to carrier transport and be able to use it to treat carrier transport in nanoscale structures as well as in bulk semiconductors.

3) Be able to derive, understand, and use the coupled current equations that describe near-equilibrium charge and heat transport by electrons and heat transport by phonons and be acquainted with basic semiconductor characterizations techniques used to measure near-equilibrium transport coefficients.

4) Be familiar with the Boltzmann Transport Equation (BTE) and how to solve it under near-equilibrium conditions with and without a magnetic field applied.

5) Be acquainted with the treatment of far from equilibrium transport with moments of the BTE, by Monte Carlo simulation, and by quantum transport. Understand high-field or "hot carrier" transport in bulk semiconductors.

6) Appreciate the non-local, ballistic and quasi-ballistic transport effects that occur in modern semiconductor devices.