**Course Topics**

**EEE 534: Semiconductor Transport**

**Prerequisites:** EEE 434 or instructor approval

**Catalog Course Description:** Understanding low-field and high-field semi-classical transport theory

**Course Topics:**

[Review of Statistical Mechanics](http://vasileska.faculty.asu.edu/EEE534/StatisticalMechanics.pdf)

[Quantum Theory of Electrons in Periodic Lattices](http://vasileska.faculty.asu.edu/EEE534/QuantumTheoryofElectrons.pdf)

[Lattice Dynamics](http://vasileska.faculty.asu.edu/EEE534/Lattice%20Dynamics.pdf)

[Time-Dependent Perturbation Theory](http://vasileska.faculty.asu.edu/EEE534/qm008.pdf); [Side Notes on Variable Matrix Elements](http://vasileska.faculty.asu.edu/EEE534/Variable%20Matrix%20Element.pdf)

Scattering Rates Calculation for Bulk Carriers:

1.     [Deformation Potential Scattering](http://vasileska.faculty.asu.edu/EEE534/DeformationPotential.pdf)

2.     [Non-Polar Optical Phonon Scattering](http://vasileska.faculty.asu.edu/EEE534/NonPolarOpticalPhononScattering.pdf)

3.     [Polar Optical Phonon Scattering](http://vasileska.faculty.asu.edu/EEE534/polarScattering.pdf)

4.     [Piezoelectric Scattering](http://vasileska.faculty.asu.edu/EEE534/piezoelectric.pdf)

5.     [Intervalley Scattering](http://vasileska.faculty.asu.edu/EEE534/intervalleyscattering.pdf)

6.     [Carrier-Carrier Scattering](http://vasileska.faculty.asu.edu/EEE534/carrierscattering.pdf): Binary Collisions and Plasma Excitations

Confined Carriers - [Some Introductory Comments](http://vasileska.faculty.asu.edu/EEE534/confined_general.pdf)

1. Scattering Rates Calculation – [Acoustic Phonons](http://vasileska.faculty.asu.edu/EEE534/confined_acoustic.pdf)
2. [Surface/Interface-Roughness](http://vasileska.faculty.asu.edu/EEE534/confined_roughness.pdf)
3. [Coulomb Scattering](http://vasileska.faculty.asu.edu/EEE534/confined_Coulomb.pdf) of Confined Carriers

Boltzmann Transport Equation (BTE)

1.     [Introductory Concepts](http://vasileska.faculty.asu.edu/EEE534/BTE.pdf)

2.     [Relaxation-Time Approximation](http://vasileska.faculty.asu.edu/EEE534/RTA.pdf)

3.     [Conductivity Calculation](http://vasileska.faculty.asu.edu/EEE534/conductivity.pdf)

4.     [Rode’s Iterative Method](http://vasileska.faculty.asu.edu/EEE534/Rode.pdf)

5.     [Orthogonal Polynomials, Conductivity Calculation](http://vasileska.faculty.asu.edu/EEE534/orthogonalconductivity.pdf)

6.     [Transport in a Weak and Strong Magnetic Field](http://vasileska.faculty.asu.edu/EEE534/magnetic.pdf)

7.     [Thermoelectric Effects](http://vasileska.faculty.asu.edu/EEE534/thermal.pdf)

8.     [Limitations of the BTE](http://vasileska.faculty.asu.edu/EEE534/LimitationsBTE.pdf)

9.     [High-Field Transport](http://vasileska.faculty.asu.edu/EEE534/HFT_general.pdf) – General Considerations: Velocity Saturation and Velocity Overshoot

Monte Carlo Method for Solving BTE at High Fields

1.     [Monte Carlo and Path Integral Formulation](http://vasileska.faculty.asu.edu/EEE534/MC_path.pdf)

2.     [Single Particle and Ensemble Monte Carlo Method](http://vasileska.faculty.asu.edu/EEE534/MC_ensemble.pdf)

3.     Many-body and Degeneracy Effects

Hydrodynamic Modeling: [Derivation of the Hydrodynamic Equations](http://vasileska.faculty.asu.edu/EEE534/Hydrodynamic.pdf)