<u>ECE 215B Draft Syllabus</u>

- **Chap. 7: Electrostatic Effects in Solids**
  - **Macroscopic behavior and polarization field**
  - **Microscopic behavior: Lorentz dipolar model and Clausius-Mosotti relation**
  - **Types of electric polarizability: Atomic and Ionic**
  - **Ferroelectricity, criticality, and associated crystal types**
  - **Intro to Effective Medium Theory: Maxwell -Garnett (Optional)**
- **Chap. 8: Magnetic Properties**
  - **Macroscopic behavior and magnetization field**
  - **Microscopic behavior: Lorentz dipolar model**
  - **Types of magnetic polarizability: classical diamagnetism and quantum paramagnetism**
  - **Review of orbital and spin angular momentum in quantum mechanics**
  - **Spin-spin interaction, ferromagnetism, criticality, and exemplary materials**
  - **Spin-spin collective excitations: spin waves and magnons (Optional)**
- **Chap. 9: Classical Transport Theory**
  - **Kinetic theory of electrical transport**
  - **Kinetic theory of thermal transport**
  - **Boltzmann transport equation and effects of scattering and particle statistics**
  - **Boltzmann electrical transport**
  - **Boltzmann thermal transport (Optional)**
- **Chap. 10: Semiclassical Transport Theory**
  - **Semiclassical equations-of-motion and electron wave-packet dynamics in a crystal**
  - **Effect of scattering; relaxation-time approximation**
  - **Electrical conductivity and effect of carrier statistics and magnetic field**
  - **Band-structure effects: hole-theorem, conductivity effective mass.**
  - **Quantum-mechanical scattering theorem**
- **Chap. 11: Examples of Semi-Classical Transport**
  - **Ionized impurity scattering**
  - **Acoustic phonon scattering and piezoelectric mediation**
  - **Optical phonon scattering via polar interaction**
  - **Combined ionized impurity and phonon scattering**
  - **Specific examples: silicon and GaAs**
- **Chap. 12: Drift-Diffusion Formalism**
  - **Open system model, conservation of charge, and local thermodynamic equilibrium**
  - **Derivation of the "master" equations.**
  - **Ambipolar effects and minority-carrier bottleneck.**
  - **Generation and recombination: Shockley-Hall-Read model**
  - **Macroscopic diffusion and semi-classical thermal transport**
- **Chap. 13: Quantum Electrical Transport (Optional)**
  - **Definitive conditions: the Ioffe-Regel criterion**
  - **Tunneling theory: stationary state and transfer Hamiltonian methods**
  - **Quantum conductance and the Landauer formula**
  - **Electrical transport in non-crystalline solids: hopping conductivity, percolation, Anderson localization, and Mott transition**