ECE 471A: Semiconductor Physics

Concepts:
- Introduction to Quantum theory of solids
  - Crystal structure of solids
  - Schrödinger equation for free electron and different potentials of interaction.
  - Concept of confinement and tunneling
- Basic semiconductor band structure
  - Conduction and valence bands
  - Energy gap
  - Density of states
  - E vs k diagram
  - Effective mass
- Carrier statistics
  - Intrinsic concentration, doping.
  - Occupation probability
  - Fermi-Dirac and Maxwell-Boltzmann distributions
- Carrier transport
  - Drift, mobility
  - Diffusion, Einstein relation

Applications:
- Microelectronics
- Semiconductor processing
- VLSI

Basic Physics of Semiconductors
- Understand how the electronic structure of solids is obtained
- Draw and interprets E vs k diagrams
- Understand the concept of electron and hole states
- Understand effective mass
- Calculate density of states
- Calculate intrinsic, doped, equilibrium, and non-equilibrium carrier concentrations
- Describe Fermi level concept and calculates Fermi energy from carrier concentrations
- Understand Fermi-Dirac distribution and assumptions that lead to the Maxwell-Boltzmann approximation
- Calculate conductivity of semiconductors from material parameters
- Understand drift and diffusion and calculates the corresponding currents

Semiconductors Structural and Electronic Properties
- Describe crystal structures
- Understand Miller indices
- Use the concepts of electron and hole transport to calculate macroscopic properties of materials
- Understand how the electronic structure of material is modelled
- Calculate current density from fundamental principles