

Materials 760 Electronic Materials, September 2024, 3 units

Course Outline:

This introductory course is intended for Materials Science and Engineering graduate students seeking knowledge of the Electronic Properties of Materials at the graduate level. Coverage includes magnetic and dielectric materials with an emphasis on semiconductor materials.

Students wishing to further extend their knowledge can take follow-on course Materials 792 offered in January 2025 covering Nanoscale Electronic Materials and Applications

Instructor:

Adrian Kitai

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Lectures:

3 hours per week, specific time to be determined

Lecture Schedule:

Week of Sept 2: Organization of lectures

Course evaluation:

Assignments: 10%

Research Project: 40%.

Midterm Test: 20%

Final Exam: 30%

Topics covered:

- i) Introduction of quantum mechanics to describe electron behaviour in materials
- ii) The quantum well
- iii) The hydrogen atom
- iv) Quantum statistics to describe equilibrium populations of electron states

- v) Uncertainty principle
- vi) Group and phase velocities to describe electron flow in solids
- vii) Bloch functions to describe electronic states in crystalline materials
- viii) Kronig Penney and related band models to model the band gap in insulators and semiconductors
- ix) Effective mass to describe electron response to applied electric fields
- x) Semiconductor densities of states
- xi) Carrier transport in semiconductors
- xii) Einstein Relation to relate drift and diffusion of electrons
- xiii) Optical properties of inorganic semiconductors
- xiv) Doped semiconductors
- xv) The p-n junction
- xvi) Magnetic properties of materials
- xvii) Dielectric properties of materials

Textbook:

Fundamentals of Semiconductor Materials and Devices, Adrian Kitai, Wiley, 2023