

Essentials of Application Intensive Quantum Mechanics

Quantum mechanics is the basic science supporting IT/NT/BT. The purpose of this lecture series is to present an overview of quantum mechanics and key concepts and methodologies. Emphasis is placed upon highlighting applications, while minimizing or skipping detailed mathematics.

The set of topics to be covered is listed below:

- summary of classical & statistical mechanics, Boltzmann distribution, electromagnetic waves
- milestone discoveries leading to quantum mechanics; quantum of energy, photoelectric effect & photons, matter wave, H-atom theory
- Schrödinger equation; bound states & energy quantization, quantum well, quantum wire & quantum dots, sublevels & 1D, 2D, 3D densities of states
- scattering and tunneling of particles, resonant transmission, Fowler Nordheim tunneling, resonant tunneling, scanning tunneling microscope, field emission display
- highlights of Schrödinger treatment of H-atom; atomic orbital, spectroscopy
- semiconductor statistics & carrier transport: Fermi function, Fermi level, degenerate & non-degenerate concentration, mobility, diffusion coefficient, equilibrium & non-equilibrium
- p-n junction; junction band bending, ideal and non-ideal I-V modeling, photodiode, solar cell, light emitting diode (LED), laser diode
- MOSFETs; NMOS, PMOS, CMOS, channel inversion & threshold voltage, On & Off current, I-V model, DRAM, flash EEPROM, Biosensors, CMOS image sensor