

Material Science Course for EE Students

Suggested Course content

Crystal structure, quasi crystals, Diffraction by a discrete lattice, X-ray, electron and neutron diffraction, Defects, Lattice vibration - concepts of Debye and Einstein temperatures, thermal conductivity.

Quantum Mechanics and Band Structure: Nature of waves and particles, Wave-packets and uncertainty, Wave mechanics, Classical and Quantum Statistics, Density of States, Kronig-Penny model, Band structure, particle in a well, harmonic oscillator, applications to semiconductors and their doping, tunneling of particles and examples, tunneling through multiple barriers and semiconductor junctions, interaction among quantum wells for materials under electric and magnetic fields.

Dielectric properties of insulators: Types of polarizations, local field and Clausius -Mossotti equation, dielectric constants and dielectric loss, dielectric strength and insulation breakdown, capacitor dielectric materials, piezo, ferro, and pyro electricity. Quartz oscillators and filters, piezo-spark generators, uni- and multi-axial ferroelectrics, pyroelectric detectors and devices.

Magnetic properties of materials: Unpaired d electrons in solids, classification of magnetic materials: dia, para, ferro, antiferromagnetism, magnetic domains, soft and hard magnetic materials, Meissner effect, flux quantization, field penetration and high frequency effects, coherence, energy gap, Johnson junctions, SQUID, soft and hard superconductors, superconducting magnets.