NNSE 508 (8W1, 1 Cr.): : "Foundations of Nanotechnology III"
Combined with NENG452 (8W1 + 8W2, 3 Cr.)

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Text:

Electrical Properties of Materials, L. Solymar and D. Walsh

Recommended Reference Texts:

Electronic Properties of Materials, R. Hummel

Introductory electromagnetics, H. Neff

Introduction to solid state physics, C. Kittel

Semiconductor Physics, K. Seeger

WEB site for notes and home assignments:
http://www.albany.edu/~soktyabr/NNSE508/

Location: NFE 4337

	NNSE 508	NENG452
Time: 9:20pm – 10:15pm	M, W	M, W, F
Period	8W1	8W1 + 8W2
Final	03/11-12	05/10-16
Midterm	-	03/11-12
Homeworks	5 (every week or so)	5 + 2
Presentation	-	8W2
Grading	Final exam (50%) quizzes (50%)	Final exam (30%) Midterm (20%) quizzes (30%) presentation (20%)

Students who fail to turn in all homework sets will receive "Incomplete" grade for the course

Course overview (508+452)

8W1

- Review: Electostatics and magnetostatics. Coulomb law, capacitor, dipole, Gauss law, Poisson equation. Dielectirics polarization.
- Review: Magnetostatics, Lorentz force, cyclotron frequency, Ampere's law magnetic dipole, magnetization.
- Macroscopic electrodynamics. Maxwell equations, mathematics, Maxwell law, Faraday law, Ampere law. EM waves, polarization, reflection from metal. Propagation of EM Waves in dielectrics and metals, Wave impedance, Wave packet, Fourier analysis. Skin effect, Boundary conditions, wave propagation through interface, Wave packet, group velocity, dispersion. Circuits.
- Metals: Drude model, Conductivity – frequency dependence, Plasma waves, Difficulties of classical free electron model.
- Dielectrics. Polarization, Linear polarizability, Clausius-Masotti equation, Frequency dependence of polarizability, EM/optical properties of dielectrics, Ferroelectrics and piezoelectrics
- A few concepts from Quantum Mechanics. Solid state physics review: Approximations. Bloch theorem, k-vector, Brillouin zone, Tight-binding model, Almost free-electron model, Bands, Holes.
- Statistics, density of states in 0, 1, 2 and 3 dimensions, Fermi level, metals.
- Magnetic properties, Diamagnetism, Band paramagnetism, Atomic paramagnetism,
- Ferromagnetism, Molecular field theory, Exchange interaction.
- Semiconductors, statistics, scattering, transport.

Course overview (452)

8W2

- Semiconductors, Crystal symmetry, Band Structure, Effective masses, Impurities, shallow and deep levels.
- Degenerate and non-degenerate carrier statistics, Distribution functions, Fermi-level.
- Electron scattering, mechanisms of scattering, mobility, drift-diffusion.
- Optical properties of semiconductors, Absorption, Excitons, Electro-optical effects, Quantum confined Stark effect, Emission, Luminescence.
- Band engineering, alloys Stress and strain, deformation potential, Heteroepitaxy.
- Barriers, M-S junction, Schottky, Ohmic, heterojunctions.

Suggested Topics for 452 Presentation

8W2

- Methods for measuring magnetization (including SQUID Magnetometer)
- Electron spin resonance
- Magnetic semiconductors
- Spin Hall effect
- Spin-transfer torque memory and logic devices
- Colossal magnetoresistance
- Magnetic Random Access Memory
- Plasmonic materilas
- Photonic crystals
- Metamaterials