Physics 262 Fall 2006: Review of topics

Part I: Optics

- E & M Waves

  - Faraday's Law (flux, emf, Lenz' Law, magnetic energy)
  - Maxwell-Ampere Law (displacement current)
  - EM wave equation ($\vec{\mathbf{E}} \perp \vec{\mathbf{B}} \perp \hat{k}$, Maxwell's equations)
  - EM wave energy & momentum (Poynting, P_{rad}, intensity)
  - Polarization (Brewster angle, Malus' Law)

- Geometric Optics

  - Reflection & Refraction (Snell's Law, total internal reflection)
  - Images (real, virtual, multiple)
  - Spherical mirrors (imaging equation, lateral magnification)
  - Spherical refractors (imaging equation, lateral magnification)
  - Thin lenses (imaging equation, Lensmaker's equation)
  - Sign Rules!!!

- Wave Optics

  - Chromatic dispersion
  - Interference basics (constructive, destructive)
  - Reflection, transmission coefficients (intensity, amplitude)
  - Phase change physics (distance, n, hard reflection)
  - Phasor math
  - Thin films
  - Young's slits (1, 2, n slits)
  - Michelson interferometer
  - Coherence length/time (transverse, longitudinal)
  - Resolvability, diffraction limit (James Bond stuff)

Part II: Relativity

- Coordinates

  - Events, reference frames (IRFs, NIRFs)
  - Principles of Relativity, Equivalence

- Geometry

  - Galilean/Lorentz invariants (spacetime interval)
  - Spacetime diagrams (axes, scales, worldlines)
  - Euclidean/Minkowski 4-vectors (dot product)
  - Galilean/Lorentz transformations (inverses too)
  - Timelike, spacelike, lightlike (Principle of Causality, light cone)
  - Relativity of Simultaneity (time dilation, length contraction, proper time)

- Kinematics

  - Doppler effect (longitudinal, transverse, redshift)
  - Velocity transformation (Galilean, Lorentzian)
  - Twin paradox
  - 4-velocity

- Dynamics

  - Einstein postulates
  - Newton's laws in special relativity ($p = \gamma m v$)
  - Energy, momentum kinetic energy ($E^2 = p^2 c^2 + m^2 c^4$)
  - 4-momentum (length, transformation)

Part III: Quantum Mechanics

- Light-matter interactions (Old Quantum Theory)

  - Blackbody Radiation (Planck, Wien, Rayleigh-Jeans, Stefan-Boltzmann)
  - Photoelectric effect
  - Bremsstrahlung
  - Thermionic emission
  - Moseley's Law
  - Compton effect
  - Quantum hypotheses (Planck, Einstein, Bohr, de Broglie)

- Atomic structure (Old Quantum Theory)

  - Line spectra (Balmer, etc. formulas)
  - Thomson vs. Rutherford atom
  - Bohr model (Derivation, E_n, r_n, reduced mass, line spectra)

- Probabilistic/wave nature of light & matter (Quantum Mechanics)

  - Single photon, e^- diffraction
  - de Broglie wavelength
  - Heisenberg uncertainty relations ($\Delta E \Delta t$, $\Delta x \Delta p$)
  - Born interpretation ($\langle f(x) \rangle$, $\int |\psi|^2 = 1$)
  - Schrödinger equation ($\mathbb{C}$, time independent, dependent versions)
  - Solving Schrödinger's equation (Boundary conditions)
  - Potential wells and barriers (infinite well ψ_n, E_n; tunneling)