Course review I

- Complex notation for waves; in optics the electric field is given by $E = \mathrm{Re}[\psi]$.
  - Beats.
  - Coherent and incoherent wave addition.
  - Nodes and fundamental frequencies.
- Oscillator theory
  - Harmonic oscillators and resonance.
  - damped-driven harmonic oscillator, magnitude and phase response, Q factor.
  - Coupled oscillators.
- Light as an EM wave.
  - Dominant effect is dielectric response to electric field.
  - Rayleigh scattering: frequency trend, angular distribution.
  - Damped, driven harmonic oscillator model of the refractive index.
  - Plasma frequency as dividing line between low (visible) and high (X-ray) frequencies.
  - Group and phase velocities.
- Ray optics and refraction.
  - Why (and when) waves can be treated as rays.
  - Snell's law.
  - Critical angle.

Course review II

- Lenses and imaging.
  - Thin lens equation.
  - Imaging basics.
  - Optics of the eye.
  - Matrix methods.
  - Spherical aberrations.
  - Chromatic aberrations and achromats.
- Polarization
  - Linear and circular.
  - Polarizers and quarter wave plates.
  - Jones equations.
- Refractive interfaces
  - Fresnel equations, reflectivity, transmittance.
  - Critical angle, Brewster's angle.
  - Stokes equations.
  - Glass slab reflectivity, finesse.
  - Metals, semiconductors, and absorption.

Course review III

- Diffraction and interference.
  - Diffraction from an aperture, and interference from slits.
  - Fresnel-Kirchoff diffraction integral and the Huygens construction.
  - Fresnel and Fraunhofer approximations.
  - Wavefield propagation and holography.
  - Rayleigh resolution.
  - Gratings and monochromators.
- Fiber optics
  - Numerical aperture and skip length.
  - Single modes, and coherence phase space.
  - Optical communications.
- Lasers.
  - Einstein A and B coefficients..
  - Population inversion, pumping, resonant cavities.
- Nonlinear optics.
  - Nonlinear response in media, and frequency doubling.
  - Pockels cells.
  - Acousto-optic modulators.

Exam

- I'll be posting solutions to today's homework by tomorrow, as well as the equation sheet for the exam.
- On the first two exams, the problems were largely drawn from the assigned homework.
- The final will be roughly 1/3 on material since exam 2 (*i.e.*, HW 8 and 9), and 2/3 on material covered on the first two exams. But this is only approximate!
- I may well have one or two essay questions, where I ask you to discuss some optical phenomena. These questions will reward those who have been attending the lectures and participating in the discussions!
- I will be around my office most of the time from 11 am til 5 pm on Monday, with a possibility of a meeting thrown in there. If I'm gone I'll put a note on my door with my return time.
- Exam is in this room, from 2-4:30 pm, on Wednesday, Dec. 17. Francis Paraan will be proctoring the exam as I'll be in California on Tuesday and Wednesday. I'll be reading my email. . .

Beyond this course

Wave phenomena are widespread in physics and beyond! Quantum mechanics, accelerator physics, music, oceanography, Bose-Einstein condensates. . . Keep thinking about waves and optics, and also keep in touch!