

## Oral Qualifying Exam – Optical Properties of Materials

This exam covers two parts, basic optics and materials that have interesting optical properties. The qualifying exam will emphasize the materials component, but not to the exclusion of basic optics.

### Optics:

- refraction, diffraction, interference, scattering, dispersion
- imaging theory, thin lenses
- nonlinear optics: 1st, 2nd and 3rd order effects, self-focusing
- photonic bandgaps
- waveguide optics
- birefringence, circular dichroism
- electro-optic, strain-optic and thermo-optic effects
- stimulated and spontaneous emission; lasers
- optical materials metrology: ellipsometry, prism coupling, forms of optical microscopy (two photon, phase contrast, dark field, etc.), photoluminescence, etc.

### Optical Materials:

- liquid crystals, polymer dispersed liquid crystals
- electro-optical materials
- organics and inorganics
- sol-gel derived glasses
- electroluminescent materials - organics and inorganics
- thin film multilayer assemblies
- semiconductor quantum dots
- colloids
- photopolymers, photoresists, holographic materials
- nonlinear optical polymers and inorganic crystals
- organic dyes
- electroabsorptive materials
- inorganic materials for optoelectronics: integrated optics, lasers, modulators, etc.
- solar cells, photodetectors

The required knowledge of optics is at the level of a sophomore/junior undergraduate physics course. There are no comprehensive optical materials texts, and few if any such courses. Two useful books, each of which covers some subset of the topics above, are "Optical Materials: An Introduction to Selection and Application," by Solomon Musikant, and "Optical Materials," by Roger M. Wood.

Students may wish (but are not required) to take the course MSE 498JR, Optical Materials and Devices.