Optics Syllabus

A. Geometric Optics (6 lectures)

Elementary geometrical optics in the paraxial approximation. Refractive index; reflection and refraction at a plane boundary from Huygens' principle and Fermat's principle; Snell's Law; total internal reflection. Image formation by reflection at a spherical boundary; concave and convex mirrors. Real and virtual images. Magnification. Image formation by refraction at a spherical boundary and by converging and diverging thin lenses. Derivation of the expression for the focal length of a thin lens.

Non-examinable: Image formation by systems of thin lenses or mirrors as illustrated by: a simple astronomical telescope consisting of two convex lenses, a simple reflecting telescope, a simple microscope.

B. Wave Optics (5 lectures)

Simple two-slit interference (restricted to slits of negligible width). The diffraction grating, its experimental arrangement; conditions for proper illumination. The dispersion of a diffraction grating. (The multiple-slit interference pattern and the resolution of a diffraction grating are excluded.) Fraunhofer diffraction by a single slit. The resolution of a simple lens.

Resources

1. Website

My website at http://www-pnp.physics.ox.ac.uk/~gwenlan/teaching/optics.html will contain the most up to date versions of handouts and other materials, as well as links to useful resources on the web.

2. Web pages

There are many useful web pages on the internet, although these should be treated with some caution! One *relatively* safe source is HyperPhysics and *some parts* of Wikipedia are useful, especially for aberrations. A particularly nice feature of web resources is the use of java applets and other active pages which illustrate topics such as refraction.

3. Books

Optics is either very simple, or very, very complicated. As a consequence of this it is hard to find entirely suitable text books. Many optics texts concentrate on the "very, very complicated" bits, and pass over the "very simple" bits in a few pages. For this reason you may find more appropriate treatments in single-volume physics texts.

a) Optics texts

- *Optics* by Hecht, 4th edition (earlier editions are by Hecht and Zajac). A nice detailed text with some lovely illustrations. Goes far beyond what you need, but does give detailed treatments of the bits you do need.
- *Optical Physics* by Lipson, Lipson and Lipson, 4th edition. A slightly smaller version of Hecht; good on telescope design and aberrations.
- *Optics and Photonics* by Smith and King. Goes far beyond what you need, but covers the bits you do need very briefly.
- *Introduction to Modern Optics* by Fowles. Goes far beyond what you need, but clearly written; a nice choice if you want to look beyond the syllabus, but don't tackle it before the end of Hilary Term.
- *Modern Classical Optics* by Brooker. A very carefully written text, but very challenging at this level.

b) Single volume texts

- *Physics by Example* by Rees. 200 worked problems on many topics including optics. Useful as a survival aid.
- *Essential Principles of Physics* by Whelan and Hodgson. An old S-level text from the 1970s; way out of print but copies can be found. Dull as ditchwater but covers the essentials in quite a detailed way; my lectures are largely based on it. Other A-level and S-level texts published between 1960 and 1980 are also worth a try.
- *Fundamentals of Physics* by Halliday, Resnick and Walker. A student-friendly basic guide.
- *The Elements of Physics* by Grant and Phillips. Full of typos but otherwise not too bad.
- *Feynman lectures on Physics*. Interesting but idiosyncratic. Largely based on Fermat's approach.