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University of Oregon; Winter 2008

Physics 352 – Part 1 – Optics

List of things to study for the Midterm Exam

NOTE: This list is intended only as an approximate guide to the topics with which you should be familiar, in preparation for the upcoming exam. There will certainly be topics listed here that are not present on the exam. And of course, this list won't spell out exactly everything that will show up in the midterm – it is meant only as an approximate guide.

Format of the exam: The exam (Mon. Feb. 4) will be closed book / closed notes, and 50 minutes long. Some information will be supplied to you (see below).

General advice: Study your homework assignments and notes. Be sure to study the *solutions* to homework problems you didn't understand. Understand the *derivations* of everything, not just the results.

- Understand the relationships between frequency (f), wavelength (λ), speed, and index of refraction for the propagation of electromagnetic waves.
- Understand how path length differences lead to phase differences for interfering waves, and how these determine the resulting light intensity.
- Snell's Law (remember it – Snell's Law will not be supplied to you).
- Total internal reflection: Understand the conditions under which it occurs; be able to calculate the critical angle.
- Understand Fermat's principle.
- Be able to derive the 2-slit interference intensity function, $I(\theta)$; determine the position of the m^{th} intensity maximum away from the normal ($\theta = 0$).
- Understand *N*-slit and single-slit diffraction.
- Understand angular resolution – how to calculate it and what it means.
- Lenses: Be able to draw ray diagrams (e.g. illustrating the focusing of parallel rays) and apply the equations relating object and image distances. Understand real and virtual images. Be able to analyze simple combinations of lenses.

YOU WILL BE GIVEN:

N-slit interference:

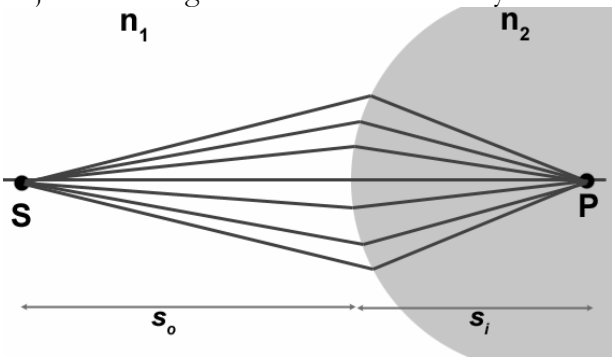
$$I(\theta) = I_0 \frac{\sin^2\left(N\pi D\sin(\theta)/\lambda\right)}{\sin^2\left(\pi D\sin(\theta)/\lambda\right)}$$

Single-slit interference:

$$I(\theta) = I_0\left(\frac{\sin(\beta)}{\beta}\right)^2, \text{ where}$$

$$\beta = \pi a \sin\theta / \lambda .$$

For a convex spherical interface of radius R, the object and image distances are related by



$$\frac{n_1}{s_o} + \frac{n_2}{s_i} = \frac{(n_2 - n_1)}{R}$$

in the paraxial regime. The distances s_o and s_i are measured as positive to the left and right of the interface, respectively.

The thin lens formula for a lens of index of refraction n_{lens} in air:

$$\frac{1}{s_o} + \frac{1}{s_i} = (n_{lens} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right), \text{ where}$$

R_1 and R_2 are the radii of curvature of the left and right lens surfaces, respectively.

Some trigonometric identities:

$$\sin(u \pm v) = \sin u \cos v \pm \cos u \sin v; \quad \cos(u \pm v) = \cos u \cos v \mp \sin u \sin v$$

$$\sin(2x) = 2\sin(x)\cos(x)$$