Preparation Notes for Chapter 37 (Interference; 2-3 classes)

Introduction to Interference of Light

Reading is 37.1-37.2 plus first section of 18.1; review problems 37.13,37.59

(1) Introduction (need this because we are doing light before sound): instructor leads in by saying have been talking about water waves, waves in air, waves in string; now light waves; we will be specifically concerned with interference of light waves, since this reveals the wave nature of light particularly clearly; need some background on superposition of waves: net displacement of medium = sum of displacements from the two individual waves; example of two waves traveling same direction, same f,λ, A but different ϕ; $y = 2Acos(\phi/2)sin(kx - \omega t + \phi/2)$ (using $y = y_1 + y_2$ and $sin(a) + sin(b) = 2cos(a - b)/2sin(a + b)/2$;

(2) Discussion (small groups): "What are some of the reasons that might explain why we don't see interference of light any time we have 2 light sources?"; need coherent light sources; incoherent light sources have small random changes in phase every 10^{-8} s; also hard to observe because wavelength is so short; helps if source is monochromatic; get sources in constant phase relationship by using one source to illuminate two slits

(3) Describe geometry of Young's double slit experiment; dark bands called fringes; path difference $\delta = dsin\theta$; if $\delta = m\lambda$ or $dsin\theta = m\lambda$ get constructive interference; if $dsin\theta = (m+1/2)\lambda$ get destructive interference; positions y of bands; $tan\theta = sin\theta = y/L$; $y_{bright} = m\lambda L/d$

(4) Discussion (small groups): "What pattern would you expect to see with three slits?"; large and small maxima, one each

(5) (Optional) Discussion: Q37.4 (what would happen in a double slit if we had white light instead of monochromatic light?)

(6) Student presentation on interference with an umbrella (note I think this is really diffraction, not interference; need to think about it some more)

(7) Problem 37.59; use to cover 180 degree phase shift on reflection

Focus on Thin Films

Reading is 37.5-37.6; review problems 37.35,37.55

(1) Discussion (whole class): Where have you seen thin films? (oil on water, coatings on camera lenses, butterfly wings, peacock feathers, hummingbird throats)

(2) Presentation on soap bubbles (thin films)

(3) Followup/discussion of thin films: $2nt = (m + 1/2)\lambda$ for constructive interference for soap bubble (uses $\lambda_n = \lambda_{air}/n$ and 180 degree phase reflection); discuss how situation changes for air/oil/water situation; in problems need to identify the thin film; note that delays can be due to either pass differences or phase change on reflection

(4) (Optional) Problem 37.35 (fairly boring, but simple)

(5) Discussion (small groups): If we treat a peacock feather as a 2-layer structure, how must the thickness vary to produce the pattern of colors we see? (I use a crude sketch of the color pattern in a peacock feather to stimulate the discussion here; this was good, brought out some confusion in one class)

(6) Problem 37.55 (if time)

(No concept map available yet for this chapter.)

Suggested Presentation Topics

See master list