PHY431, Homework 9, Due Thursday, April 27, 2017

1. (5 pts) A plane wave of wavelength λ is incident on a system having 3 slits of width a separated by distances d. The middle slit is covered by a filter which introduces a π phase change. Calculate the angle θ for the

    a. the first diffraction minimum
    b. the first interference minimum
    c. the first interference maximum

    Remember: 'diffraction' here is referring to the effects coming from the finite slit width, and 'interference' is referring to the effects coming from the set of multiple slits (e.g., Young's).

    Hint: for the interference cases b and c, you may use either graphical or analytic methods.

2. (5 pts) A diffraction grating has N lines spaced a distance d apart. Monochromatic radiation of wavelength λ is incident normally on the grating; radiation emerges at an angle θ and is focused by a lens onto a screen.
    a. Derive an expression for the intensity distribution of the interference pattern as a function of θ. Neglect the effect of diffraction due to finite slit width.
    Hint: it is not necessary to completely recopy the derivation from class. Give the 'interference' expression (see problem #1) and explain carefully in words.

    b. The resolving power $\Delta\lambda/\lambda$ of a grating is a measure of the smallest wavelength difference which a grating can resolve. The resolving power can be estimated using the Rayleigh criterion stating that two spectral lines are just resolved when the maximum of one line coincides with the minimum of the other. Using the Rayleigh criterion show that the resolving power in order m is $\Delta\lambda/\lambda = 1/mN$.