PHYS 306 Spring 2010
Wave Motion and Electromagnetic Radiation

Homework Assignment

HW#5
Assignment Date: Feb. 23, 2010
Due Date: Mar. 2, 2010

1. Starting from the definition of the group velocity, show that

$$\frac{1}{v_g} = \frac{1}{c}[n(\lambda_0) - \lambda_0 \frac{dn}{d\lambda_0}]$$

2. Let

$$n(\lambda_0) = n_0 + A\lambda_0$$

(1) Derive the expression for phase velocity
(2) Derive the expression for group velocity
(3) Derive the expression for the dispersion coefficient

3. For pure silica we may assume the empirical formula

$$n(\lambda_0) = 1.451 - 0.003(\lambda_0{}^2 - \frac{1}{\lambda_0{}^2})$$

where λ_0 is measured in μm

(1) Calculate the phase velocity at 0.8 μm
(2) Calculate the group velocity at 0.8 μm
(3) Calculate the dispersion coefficient at 0.8 μm
(4) Considering a LED source emitting a pulse of light of wavelength at 0.8 μm and have a spectral width of 50 nm, what is the broadening time of the pulse over a distance of 2 km.
(5) Calculate the wavelength with zero dispersion.

Note: Please pay attention to the units.