EE2190 Quiz 4, Spring 2004

Show your work for full credit. Express ALL answers in MKS (meters, kilograms, seconds).

1. An underwater swimmer shines a beam of light towards the surface. It strikes the air-water interface at 35° (measured relative to the normal, as always). At what angle does it emerge? Assume the index of refraction of water is 1.33. (4 pts)

\[ \theta_a \sin \theta_a = n_\lambda \sin \theta \lambda \]

\[ \theta_a = \sin^{-1} \left( 1.33 \sin 35^\circ \right) \]

\[ = 49.7^\circ \]

2. Light having a vacuum wavelength of 632 nm (He-Ne laser beam), traveling in glass (n=1.6), is incident at 45° on a glass-air interface. Determine the distance into the air at which the amplitude of the evanescent wave drops to 1/e of its maximum value at the interface. (4 pts)

\[ \beta = k \left[ \left( \frac{\sin \theta \lambda}{n_\lambda / n_\lambda} \right)^2 - 1 \right]^{1/2} \]

\[ = \frac{2 \pi}{632 \text{ nm}} \left[ \frac{\sin 45^\circ}{(1/1.6)^2} - 1 \right]^{1/2} = 5.26 \times 10^{-6} [\text{m}] \]

\[ \therefore \beta = 1 \Rightarrow \gamma = \frac{1}{5.26 \times 10^{-6}} = 1.9 \times 10^{-2} \text{ m} \]