PHY1106: Waves and Oscillators	Dr. Pete Vukusic

Lecture 19.

Lecture objectives.

- To derive expressions for transmitted and reflected power at a junction between two media of different impedance *z*.
- To consider energy conservation in the special cases discussed in lecture 18.
- To understand the concept of impedance matching at an interface in significant detail.
- To derive and manipulate reflection and transmission coefficients (in terms of *z*), for the case of a quarter-wave transformer (impedance matching case), so that zero reflection is produced.

Post-lecture tasks.

- The wave equation for the electric field component of the electromagnetic wave in dielectrics is

$$\frac{\partial^2 E_x}{\partial z^2}\frac{1}{\varepsilon\mu} = \frac{\partial^2 E_x}{\partial t^2}$$ (careful how you interpret this equation!)

  where the permeability and permittivity are μ and ε respectively.
- Write down a wave function E_x which satisfies this equation and specify the direction of the wave propagation.
- Express the phase velocity v of this wave in terms of μ and ε and calculate the refractive index $n=c/v$ for a dielectric with $\mu = \mu_0$ and $\varepsilon = 10\varepsilon_0$.
- The characteristic impedance of dielectrics to electromagnetic waves is

$$Z = \left(\mu / \varepsilon\right)^{1/2}$$

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  The reflection coefficient for incident light passing from a medium with impedance Z_1 to a medium with impedance Z_2 is $R = \frac{Z_1 - Z_2}{Z_1 + Z_2}$

- For the dielectric with μ and ε given above, calculate the transmission coefficient for incident light coming from free space and having a wavelength of 400 nm.
- Calculate the thickness of the anti-reflective coating for such a dielectric.