Physics 7312 Professor Scalise
Homework Assignment #5

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13. Show that the physical (real) electric field $\vec{\mathcal{E}}(\vec{r}, t)$ is constrained by

$$\sum_{i=1}^{2} \sum_{j=1}^{2} A_{ij} \mathcal{E}_i \mathcal{E}_j = 1 \quad .$$

This is a double sum over polarizations. Find the 2×2 matrix $\mathbf{A}$ and show that the tip of the electric field vector traces out an ellipse as a function of time at each point in space $\vec{r}$.

14. Show that the time average of the Poynting vector over a period of the wave is

$$< \vec{S} > = < u > \hat{k} v$$

where $< u >$ is the averaged electromagnetic energy density. Interpret the result.