

In the Name of Allah,
the Beneficent, the Merciful



School of Electrical Engineering
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Photonic Crystals

Mid-term Exam

May 19, 2015

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- 1) An external current source embedded in a photonic crystal, is known in terms of the Wannier functions as

$$\frac{1}{\sqrt{\epsilon(\mathbf{r})}} \mathbf{J}_{ex}(\mathbf{r}, t) = \begin{cases} 0 & t < 0 \\ \sum_{n\mathbf{R}} f_{n\mathbf{R}}(t) \mathbf{W}_{n\mathbf{R}}(\mathbf{r}) & t > 0 \end{cases}$$

- (a) Calculate the time-derivative of the Electric and Magnetic response fields everywhere inside the crystal.
(b) Simplify the response fields if we have

$$f_{n\mathbf{R}}(t) = e^{-\alpha t} e^{-\beta R}$$

where α and β are positive real numbers, and $R = |\mathbf{R}|$.

- 2) Three identical two-dimensional lossless cavities are considered, each having radially symmetric Gaussian monopole radiation patterns. If these are placed at the corners of an equilateral triangle, and are let to interact, what will be the new supermode frequencies and patterns? Are they non-degenerate or degenerate? Are the new eigenmodes orthogonal? If not, can you make them so? Make typical plots of new supermodes.

Good Luck