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Electromagnetic wave propagation in media whose permittivity varies periodically in time[1] JUAN CARLOS CERVANTES, PETER HALEVI —

We have developed a general theory for propagation of plane electromagnetic waves in a medium with permittivity that is varying periodically in time. The Bloch-Floquet theorem dictates that these are a superposition of harmonic modes whose frequencies differ by $2\pi/T$, where T is the period of $\varepsilon(t)$. For arbitrary periodicity, the dispersion relation $\omega(t)$ for the "Bloch frequency" is given in terms of the roots of an infinite determinant whose elements depend on the Fourier coefficients of $\varepsilon(t)$. For small variation of $\varepsilon(t)$ around an average ε_0,$\omega(t)$ is characterized by regions of the wave vector k that are forbidden for propagation. These are centered at ω and k values that are, respectively, integer multiples of π/T and of $\pi\varepsilon_0^{1/2}/cT$. The widths of the gaps are proportional to the corresponding Fourier coefficients of $\varepsilon(t)$. In the special case of square-periodic variation of $\varepsilon(t)$, there is no need to recur to a perturbational calculation, because the dispersion relation can be derived analytically, with no approximations. Again, we find wave vectors gaps whose edges are located at the frequencies $\omega = 0, \pi/T, 2\pi/T, \ldots$.

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