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 \(\varepsilon_0\), \(\omega(t)\) is characterized by regions of the wave vector \(k\) that are forbidden for propagation. These are centered at \(\omega\) and \(k\) values that are, respectively, integer multiples of \(\pi/T\) 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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