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A new resonance spectrum for quasi-periodic source free modes is identified and used to represent solution operators associated with electromagnetic and acoustic waves inside periodic high contrast media. The spectra is associated with the Neumann Poincare operator defined on the space of quasi-periodic functions. This representation extends Bloch wave band structure to complex coupling constants. The spectral representation delivers explicit convergent power series in the contrast for dispersion relations associated with Bloch waves inside periodic crystals. The representation is used to recover explicit lower bounds on the contrast between material properties that guarantee convergence of the series as well as separation of spectra for Bloch eigenvalues inside high contrast photonic crystals. (Received September 19, 2015)