Wave Equation in phasor Form

An electromagnetic wave travelling in a medium can be completely defined if the intrinsic impedance (N) and the propagation constant (Y) of the medium are known. Thus, it is necessary to derive the expressions for N and Y in terms of the properties of the medium such as the permeability (u) , the permittivity ( ) and the conductivity ( ).

Consider Faraday's law

Taking curl of both sides

Since most of the regions are source free or charge free, thus

Rewriting equation(5) in phasor form,

In a similar way, we can write the phasor equation for the H field as follows:

The terms inside the bracket in equations(6) and (7) are exactly similar and represents the properties of the medium in which the wave is propagating. The total bracket is the square of the propagation constant Y, thus equations (6) and (7) become

So the propagation constant Y can be expressed in terms of the medium properties as follows:

The real and the imaginary parts of Y are the attenuation constant and the phase constant and both can be expressed in terms of the properties of the medium.

The intrinsic impedance of the medium can expressed of the medium properties and given by:

It can also be expressed in phasor form as( ) ,where