

SNS College of Engineering Kurumbapalayam (Po), Coimbatore – 641 107 An Autonomous Institution



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# 19EC502 -Transmission Lines and Antennas Unit II- Guided Waves

### Characteristic of TE and TM WAVES

The properties of the TE and TM waves between parallel conducting planes are altogether different than those of the uniform plane waves in the free space.

From the expressions of the field components of transverse electric waves or transverse magnetic waves, it is clear that there is either sinusoidal or cosinusoidal variations or standing-wave distribution of each components of E or H in the X-direction

In y direction, none of the field components vary in magnitude or phase which is according to assumption made earlier

Thus x-y plane is an equiphase plane for each of the field components. The meaning of equiphase plane is that for all points on the plane , the maximum value of sinusoidal variation of any field component will reach its maximum value at same instant



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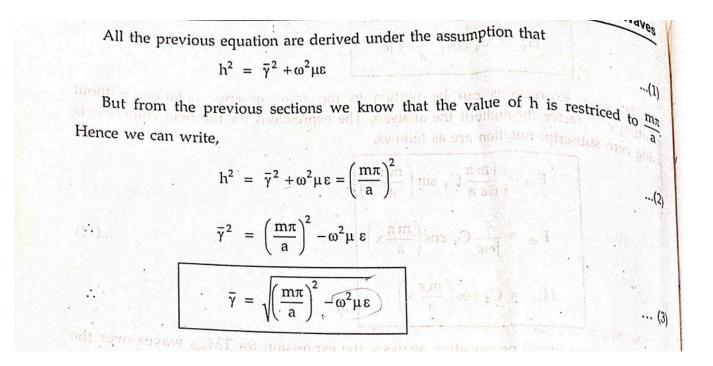
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At the lower frequencies, the value of factor  $\mu\epsilon$  is found to be less than (m $\pi/a$ )

Thus becomes real with value equal to the attenuation constant a. Under such condition, B = 0. Thus there is only attenuation suffered by the wave, without any propagation. In contrast to this, at higher frequencies, the value of the factor  $w^2 \mu \epsilon$  becomes greater that that of the factor ma making purely imaginary. Thus when y is purely imaginary, its value equals to j $\beta$  be. phase constant. Under such condition, attenuation constant is given by a = 0.



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Thus, the lower frequencies are attenuated completely, with no propagation; while the higher frequencies are allowed to propagate with appropriate phase shift only, we can conclude that, the system acts as High Pass Filter (HPF). Let the cut-off frequency of the high pass filter be fc.

The cut-off frequency can be defined as the frequency at which the propagation constant changes from being real to imaginary. In other words, it is the frequency below which signal suffers only attenuation while above it waves just start propagating. It is interesting to note that at f = fc, value of the propagation constant is zero.

tield components vary in anguitude or place, suit is For,  $f < f_c$ ,  $\left(\frac{m\pi}{a}\right)^2 > \omega^2 \mu \epsilon$ ,  $\bar{\gamma} = \alpha$  and  $\beta = 0$ For,  $f > f_{c'} = \left(\frac{m\pi}{a}\right)^2 < \omega^2 \mu \epsilon$ ,  $\overline{\gamma} = j\beta$  and  $\alpha = 0$ 



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for, 
$$f = fc$$
,  $\frac{m\pi}{a} = D^{2} \mu e$ ,  $\overline{8} = 0$   
Hence, at  $f = fc$ ,  $\pi e \omega n^{4} ling - equation (3)$ , we get  
 $D = \sqrt{\left(\frac{m\pi}{a}\right)^{2} - (ac^{2} \mu e)}$   
 $Sq. on both side
 $\left(\frac{m\pi}{a}\right)^{2} - \left(\partial_{c}c^{2} \mu e\right)^{2} = 0$ .  
 $\left(\frac{m\pi}{a}\right)^{2} = \partial_{c}c^{2} \mu e$   
 $\frac{m\pi}{a} = wc \sqrt{\mu e}$   
 $we = 2\pi fe$   
 $\frac{m\pi}{a} = wc \sqrt{\mu e}$   
 $fc = \frac{m\pi}{a \cdot 2\pi} \sqrt{\mu e}$   
 $\frac{fc}{a \cdot 2\pi} \sqrt{\mu e}$   
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 $\frac{fc}{a \cdot 2\pi} \sqrt{\mu e}$   
 $\frac{m\pi}{a \cdot 2\pi} \sqrt{\mu e}$   
 $\frac{fc}{a \cdot 2\pi} \sqrt{\mu e}$$ 

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Hence the phase shift constant can be  
written by comparison as given belows  

$$\begin{bmatrix}
P = 277 \ VHE \ VF^2 - Fe^2
\end{bmatrix} - P$$
The wavelength is degreed as the distance  
travelled for the phase shift through 200 readin.  
Thus wavelength is given by 3  

$$\begin{bmatrix}
d = 27 \\
P
\end{bmatrix} - P$$
The Cut-of usuelength (de) is given by ,  

$$\begin{bmatrix}
d = 27 \\
P
\end{bmatrix} - P$$
The Cut-of frequency is given by ,  

$$\begin{bmatrix}
d = 27 \\
P
\end{bmatrix}$$
But the Cut-of frequency is given by ,  

$$fc = \frac{M}{Fc} = \frac{mv}{2a} \quad \therefore v = \frac{1}{VHE}$$
But the Cut-of frequency is given by ,  

$$fc = \frac{M}{Fc} = \frac{mv}{2a} \quad \therefore v = \frac{1}{VHE}$$
Thus from eqn (D), the distance of depression is  
given by ,  

$$\begin{bmatrix}
a = m & Ac \\
P
\end{bmatrix}$$