Antennas & Wave Propagation

Electronic Dep.

3rd Stage

Lecture Six

R. M. S. Value of the Electric field Intensity at Distance R

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R. M. S. Value of the Electric field Intensity at Distance R

As we know $H_\phi = \frac{I_0 l_e}{2\lambda r} \sin\theta$, and $E_\theta = 120\pi H_\phi$

Then $$|H_\phi| = \frac{I_0 l_e}{2\lambda r}$$

$$|E_\theta| = 120\pi |H_\phi|$$

$$H_\phi = \frac{\omega I_0 dl \sin\theta}{4\pi c r} \sin\omega\left(t - \frac{r}{c}\right)$$

$$\omega = 2\pi f \text{ and } \frac{c}{f} = \lambda$$

$$H_\phi = \frac{2\pi f I_0 dl \sin\theta}{4\pi c r} \sin\omega\left(t - \frac{r}{c}\right)$$

$$H_\phi = \frac{I_0 dl \sin\theta}{2\lambda r} \sin\omega\left(t - \frac{r}{c}\right)$$

$$\boxed{|H_\phi| = \frac{I_0 dl}{2\lambda r}}$$

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The rms value of amplitude of electric field intensity is given by,

$$E_{rms} = \left| \frac{E_\theta}{\sqrt{2}} \right| = \frac{120\pi}{\sqrt{2}} \, |H_\phi|$$

$$= \frac{120\pi}{\sqrt{2}} \left\{ \frac{I_0 \, l_e}{2\lambda r} \right\}$$

$$= 120\pi \left\{ \frac{I_0}{\sqrt{2}} \cdot \frac{l_e}{2\lambda r} \right\}$$

$$= \frac{60\pi \, I_{rms} \, l_e}{\lambda r} \text{ volt/metre}$$

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As l_e for the grounded short antennas is $2l_e$, then

$$E_{rms} = \frac{60\pi I_{rms} \cdot 2l_e}{\lambda^2}$$

$$E_{rms} = \frac{120\pi l_e}{\lambda r} I_{rms} \text{ volt/metre}$$

$$\boxed{E_{rms} = \frac{377 I_{rms} l_e}{\lambda r} \text{ volt/metre}}$$

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Now taking the square of equation 1.47 and divided by equatioin 1.44, thus we get

$$\frac{E_{rms}^2}{P} = \frac{\left[\frac{120\pi \cdot I_{rms}\, l_e}{\lambda r}\right]^2}{\left[160\pi^2 \left(\frac{l_e}{\lambda}\right)^2 \cdot I_{rms}^2\right]}$$

$$= \frac{120\pi \times 120\pi}{160\pi^2 \cdot r^2}$$

$$\frac{E_{rms}^2}{P} = \frac{90}{r^2}$$

or

$$\boxed{E_{rms} = \frac{\sqrt{90P}}{r}}$$

where P in watts and r in meters.

So, the equation (1.49) represents the rms electric field intensity in terms of power radiated and it is very useful formula when P and r is given and we want to calculate the E_{rms}.

Thanks for Listening

Any Question Please…