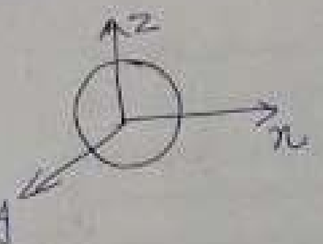
Radiation Pattern of Antenna →

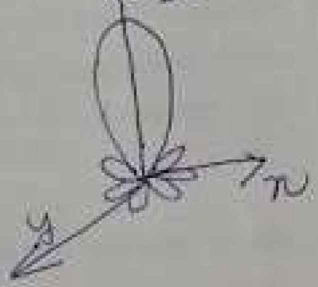
Radiation Pattern → Graphical representation of radiation as a func^n of direction.

· According to radiation pattern antenna is divided into three types →

Isotropic Antenna



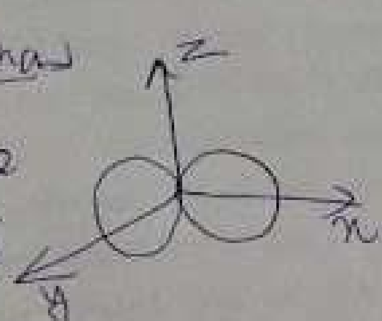
Directional Antenna



Null direction → Zero radiation
Major lobe → Max^n radiation
Minor lobe → except major lobe
Side lobe → except intended lobe
Back lobe → 180° back to major lobe.

~~Omnidirect~~

Omnidirectional Antenna



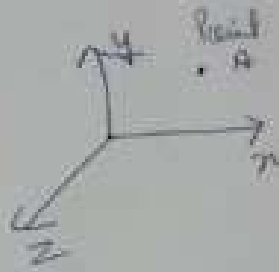
Non directional in one plane & directional in perpendicular plane

Ex → loop Antenna, dipole antenna

Normalized Electric field →

$$E_n(\theta,\phi) = \frac{E(\theta,\phi)}{E_{max}(\theta,\phi)}$$

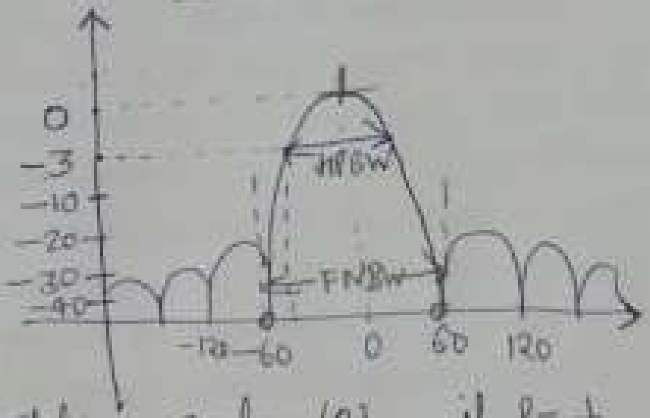
max^m value of $E_n(\theta,\phi) \le 1$



Electric field Pattern →

Normalised power pattern →

Decible plot →



Decible plot → $10\log_{10}(P)$ if $P = \frac{1}{2}$
$= -3dB$

Normalized electric field →
$$E_n(\theta,\phi) = \frac{E(\theta,\phi)}{E_{max}(\theta,\phi)}$$

Normalized Power → $P_n(\theta,\phi) = \frac{W(\theta,\phi)}{W_{max}(\theta,\phi)}$

At HPWB → $P = \frac{1}{2}$

$P \propto E^2$

$P = \frac{E^2}{\eta}$ (if $\eta = 1$)

$P = E^2$, $E = \sqrt{P} = \sqrt{\frac{1}{2}} = 0.707$

HPBW → (Half Power Beam width)
Angular distance between two points which are 3 dB below the maximum gain point.

FNBW → (First Null Beam width)
Angular distance between two points where radiation drop to '0' first time.

SLL → (Side Lobe level)

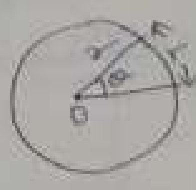
Ratio of side lobe peak to main lobe.

FBR → Ratio of gain at 0° & 180°.

Antenna Bandwidth →

~~Beam Area~~

Radian →



θ = 1 rad (when the length of arc = r)

circumference of ~~the~~ circle = $2\pi r$

∴ r length arc make = 1 rad

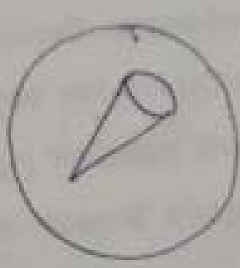
∴ So $2\pi r$ " " $= 2\pi$ rad

Steradian →

1 Str = r^2

Area of sphere = $4\pi r^2$

So for full sphere = 4π Str



for fixed value of 'r',

$d\theta = r\,d\theta$

$d\phi = r\sin\theta\,d\phi$

$ds = d\theta\,d\phi$

$= (r\,d\theta)\,r\sin\theta\,d\phi$

$ds = r^2 \sin\theta\,d\theta\,d\phi$

$$d\Omega = \frac{ds}{r^2} = \frac{r^2 \sin\theta \, d\theta \, d\phi}{r^2}$$

$$\boxed{d\Omega = \sin\theta \, d\theta \, d\phi}$$

Beam area in terms of P_n →

$$\Omega_A = \int_{\phi=0}^{2\pi} \int_{\theta=0}^{\pi} P_n(\theta, \phi) \underbrace{\sin\theta \, d\theta \, d\phi}_{d\Omega}$$

$$\boxed{\Omega_A = \iint_{4\pi} P_n(\theta, \phi) \, d\Omega}$$

Relation of Beam area with HPBW →

$$\boxed{\Omega_A = \theta_{HPBW} \phi_{HPBW}}$$

nd in ϕ).

$$= 2\pi \left. \frac{-x^5}{5} \right|_{+1}^{+0} = 2\pi \cdot \frac{1}{5}$$

$$= \frac{2\pi}{5} \text{ Sr.} = 1.25 \text{ Sr.}$$

$$\Omega_A = \int_{\theta=0}^{\pi} \int_{0}^{2\pi} P_x(\theta) \sin\theta \cdot d\theta \cdot d\phi$$

2. As we have already calculated HPBW of this pattern as 66°. Its pattern is symmetrical.

So,

$$\theta_{HP} = \phi_{HP} = 66°$$

$$\Omega_A = \theta_{HP} \times \phi_{HP} = 4356 \text{ sq. deg.}$$

$$\text{Beam Area} = \frac{4356}{3282} \text{ Sr.} = 1.33 \text{ Sr.}$$

Difference is 0.08 Sr.

And % change will be of 6%.

1.6 RADIATION INTENSITY

Power Radiated per unit area in any direction is given by pointing vector P.

$$S = \frac{E^2}{Z} \text{ watt/m}^2$$

$$dA = r^2 d\Omega$$

Radiation Intensity is defined as power radiated from an antenna per solid angle. It is represented by U (watt/Sr.).

Radiation intensity is not dependent on distance.

Total Radiated power is