Benha University **Antennas &Wave Propagation** **Electrical Eng. Dept.**
Faculty of Engineering **4^{th} year communication**
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Sheet (3)

1. A hypothetical isotropic antenna is radiating in free-space. At a distance of 100 m from the antenna, the total electric field ($\mathbf{E_\theta}$) is measured to be 5 V/m. Find the
(a) Power density (W_{rad})
(b) Power radiated (P_{rad})

2. The radiation intensity of antenna is given by $\mathbf{U=B_o Cos\theta}$. U exists only in the upper hemisphere, Find

a. The exact directivity.
b. The approximate directivity.
c. The decibel difference.

3. The power radiated by a lossless antenna is 10 watts. The directional characteristics of the antenna are represented by the radiation intensity of
$\mathbf{U=B_o cos^3\theta}$ (watts/unit solid angle) ($0\leq\theta\leq\pi/2$, $0\leq\varphi\leq2\pi$)
Find the
(a) Maximum power density (in watts/square meter) at a distance of 1,000 m (assume far-field distance). Specify the angle where this occurs.
(b) Exact and approximate beam solid angle Ω_A.
(c) Directivity, exact and approximate, of the antenna (dimensionless and in dB).

4. In target-search ground-mapping radars it is desirable to have echo power received from a target, of constant cross section, to be independent of its range. For one such application, the desirable radiation intensity of the antenna is given by

$$U(\theta,\phi) = \left\{\begin{array}{cc} 1 & 0^\circ \leq \theta < 20^\circ \\ 0.342\csc(\theta) & 20^\circ \leq \theta < 60^\circ \\ 0 & 60^\circ \leq \theta \leq 180^\circ \end{array}\right\} 0^\circ \leq \phi \leq 360^\circ$$

Find the directivity (in dB) using the exact formula.

5. The normalized radiation intensity of a given antenna is given by
(a) $U=\sin\theta\sin\varphi$, (b) $U=\sin\theta\sin^2\varphi$, (C) $U=\sin^2\theta\sin^3\varphi$

Dr. Moataz Elsherbini
Eng. Shaimaa Ezzat

The intensity exists only in the $0 \le \theta \le \pi$, $0 \le \varphi \le \pi$ region, and it is zero elsewhere. Find the

(a) Exact directivity (dimensionless and in dB).
(b) Azimuthal and elevation plane half-power beam widths (in degrees).

6. The normalized radiation intensity of an antenna is rotationally symmetric in φ, and it is represented by

$$U = \begin{cases} 1 & 0^\circ \le \theta < 30^\circ \\ 0.5 & 30^\circ \le \theta < 60^\circ \\ 0.1 & 60^\circ \le \theta < 90^\circ \\ 0 & 90^\circ \le \theta \le 180^\circ \end{cases}$$

(a) What is the directivity (above isotropic) of the antenna (in dB)?

7. The radiation intensity of an antenna is given by $\mathbf{U(\theta,\varphi)=\cos^4\theta\sin^2\varphi}$, for $0 \le \theta \le \pi/2$ and $0 \le \varphi \le 2\pi$ (i.e., in the upper half-space). It is zero in the lower half-space.

Find the

(a) Exact directivity (dimensionless and in dB)
(b) Elevation plane half-power beam width (in degrees).

8. The maximum radiation intensity of a 90% efficiency antenna is 200 mW/ unit solid angle. Find the directivity and gain (dimensionless and in dB) when the
  (a) Input power is 125.66 mW
  (b) Radiated power is 125.66 mW

9. 1GHz satellite antenna has an E-plane beam-width of 12^o and on H-plane beam-width of 10^o. The antenna conductivity and mismatch total loss -3db. Estimate the gain of antenna.

(REPORT)

1. The normalized radiation intensity of an antenna is represented by

$$U(\theta) = \cos^2(\theta)\cos^2(3\theta), \quad (0 \le \theta \le 90^\circ, \quad 0^\circ \le \phi \le 360^\circ)$$

Find the exact and approximate directivity.

Good Luck

Dr. Moataz Elsherbini
Eng. Shaimaa Ezzat