UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
School of Electrical and Information Engineering
ELEN4001 High Frequency Techniques

TUTORIAL 2—Linear Antennas

Question 1

A 50Ω shipboard antenna system consists of a 4m monopole with an impedance matching network at its base. The measured system radiation efficiency is 5% at a frequency of 3MHz. Calculate the loss resistance of the antenna at that frequency if the matching network has an efficiency of 95%.

Question 2

An omnidirectional (isotropic) antenna has a field pattern given by

$$E = \frac{10I}{r} \qquad \text{V/m}$$

where I is the terminal current and r is the distance from the source. Determine the radiation resistance. [3.33Ω]

Question 3

For a thin centre-fed dipole $\lambda/15$ long find:

- Directivity, D
- Gain, G
- effective aperture, A_e
- beam solid angle, Ω_A
- radiation Resistance, R_r

The antenna current tapers linearly from its values at the terminals to zero at its ends. The loss resistance is 1Ω.

Question 4

An antenna has a uniform field pattern for zenith angles (θ) between 45 and 90°and for azimuth angles (ϕ) between 0 and 120°. If $E = 3V/m$ at a distance of 500m from the antenna and the terminal current is 5A, find the radiation resistance of the antenna. Assume $E = 0$ except with in the angles given above. [354Ω]

Question 5

A backpacking penguin participated in a study of Antarctic penguin migration habits. Its backpack radio with a $\lambda/4$ antenna transmitted data on its body temperature and its heart and respiration rates. It also provided information on its location as it moved with its flock. The backpack operated at 100MHz with a peak power of 1W and a bandwidth of 10kHz of tone-modulated data signals. If $T_{\text{sys}} = 1000$K, and SNR=30dB, what is the maximum range? Assume both transmitting and receiving antennas to be $\lambda/4$ monopoles.

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