EE 483/583 Antennas for Wireless Communications
Quiz #1 (Spring 2024)

Name _____ *Key A* _____

Instructions: Open book & notes. Place answers in indicated spaces and show all work for credit.

At its operating frequency in free space, an antenna has a maximum directivity of 8.2 dBi. If the antenna is lossless and has an input power of 12 W, find the maximum directivity (unitless) and maximum radiation intensity. Lastly, determine the power density as well as electric field strength at a distance of 280 m in the direction of maximum directivity.

$$8.2 \, dB_i = 10 \log_{10} D_{max}$$

$$\hookrightarrow D_{max} = 10^{8.2/10} = 6.6069345$$

$$\text{Lossless antenna} \Rightarrow P_{rad} = P_{in} = 12W$$

$$(2\text{-}16a) \quad D_{max} = \frac{4\pi U_{max}}{P_{rad}}$$

$$\hookrightarrow U_{max} = \frac{P_{rad}}{4\pi} D_{max} = \frac{12}{4\pi} 6.607 = 6.30916 \, W/sr$$

$$(2\text{-}12) \quad U = r^2 W_{rad} \Rightarrow W_{rad} = \frac{U}{r^2} = \frac{6.3092}{280^2} = W_{max}$$

$$W_{max} = 8.0474 \times 10^{-5} \, W/m^2$$

$$(Notes) \quad \overline{W}_{ave} = \hat{a}_{1C} \frac{|\bar{E}|^2}{2\eta} \Rightarrow W_{rad} = \frac{|\bar{E}|^2}{2\eta} = W_{max}$$

$$|\bar{E}| = E_{max} = \sqrt{2\eta_0 W_{max}} = \sqrt{2(376.73) \, 8.0474 \times 10^{-5}}$$

$$= 0.24624 \, V/m$$

$D_{max} = \underline{6.607}$ $U_{max} = \underline{6.309 \, W/sr}$ $W_{max} = \underline{80.474 \, \frac{\mu W}{m^2}}$ $E_{max} = \underline{0.2462 \, V/m}$