ECEG 390 Theory and Applications of Electromagnetics Spring 2025

Selected Answers to HW #9

Include explanatory text and intermediate calculations in your solutions. You will not receive credit for merely repeating an answer given here without supporting work.

If an answer is not provided below, it is either because the solution is trivial or because disclosure of the answer would give away too much of the solution.

If you suspect that an answer below is incorrect, please let me know as soon as possible.

1. **a.** $\hat{\mathbf{e}}_{TX} = \hat{\boldsymbol{\varphi}}\,0.2169 + \hat{\boldsymbol{\theta}}\,0.9762e^{-j0.1\pi}$

b. P_{RX} = 100 nW; intermediate result: PLF = 0.953

2. PLF = 0.435

3. $\varepsilon = 1.1 \times 10^{-10}$ F/m (or 12 ε_0); $\sigma = 0.56$ mS/m; $u_p = 8.5 \times 10^7$ m/s

4. $0 < f < 41$ MHz

5. **a.** $\alpha = 0.0011$ Np/m, $\beta = 0.0011$ rad/m, $\lambda = 5.8$ km, $\delta_s = 920$ m

b. [answer not given]

c. [answer not given]

d. [answer not given]

e. $\alpha = 0.243$ Np/m, $\beta = 198$ rad/m, $\lambda = 3.2$ cm, $\delta_s = 4.1$ m

6. **a.** $\alpha = 1.6 \times 10^{-5}$ Np/m

b. $\beta = 630$ rad/m

c. at $z = 5{,}000$ m, $|\mathbf{S}_{av}| = 7.3 \times 10^{-20}$ W/m^2 without atmospheric loss included; $|\mathbf{S}_{av}| = 6.2 \times 10^{-20}$ W/m^2 with atmospheric loss included

d. Difference in power densities due to path Loss = −0.71 dB