

PhD Preliminary Written Exam

Problem 8

Spring 2014

Transmission Lines and Fields

Note that $\epsilon_0 = 8.8542 \cdot 10^{-12}$ F/m, and $\mu_0 = 4\pi \cdot 10^{-7}$ H/m.

A A vertically polarized plane wave traveling in the horizontal direction in free space, with the electric field magnitude of 10 V/m, at a frequency of 10 GHz.

(a) What is the power density in this wave? (0.25) points

This wave impinges on an antenna which can only receive right circularly polarized signals, and the effective area corresponding to this circular polarization is 1 m^2 .

(b) Determine the power received by this antenna and associated receiver. (1.0) points

To protect the antenna from the environment a Si_3N_4 , $\epsilon_r = 4.0$, flat panel 1.0 cm thick is placed in front of the antenna at an angle to vertical.

(c) At what angle to the vertical should this panel be placed to allow the wave to travel unimpeded, with no reflections? (0.75) points

B A ferrite core antenna used in AM radio sets is 10 cm long, has a diameter of 1 cm, and a relative permeability of 100. It has 200 turns wound on it over its entire length.

(a) determine the inductance of this coil. (0.67) points

A second coil is wound on top of the first, with 50 turns, for a length of 2.5 cms.

(b) What is the self inductance of this second coil. (0.67) points

(c) What is the mutual inductance between the coils? (0.67) points